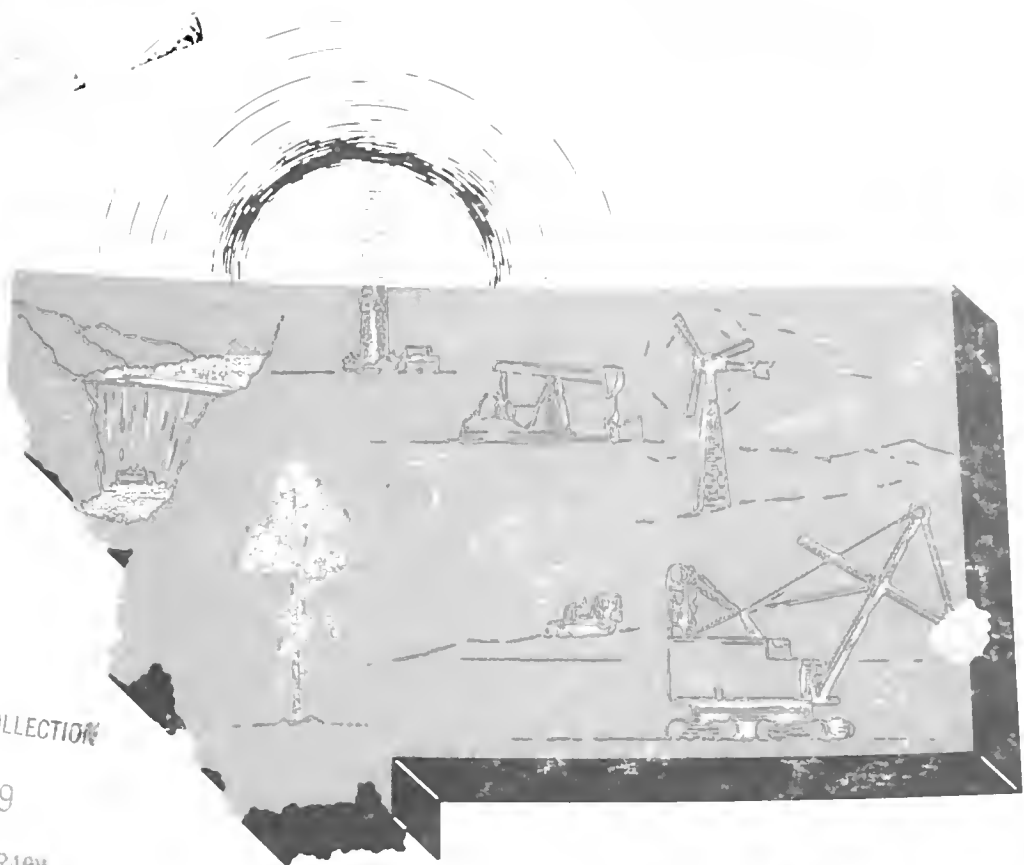


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DIRECTORY OF MONTANA ENERGY RESEARCH & DEVELOPMENT PROJECTS



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**DIRECTORY OF
MONTANA
ENERGY RESEARCH AND DEVELOPMENT
PROJECTS**

Compiled By
Nancy B. McLane

Montana Energy Office
Capitol Station
Helena, Montana 59601

January 1978

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INTRODUCTION

The Montana Energy Office (MEO) has, as one of its primary functions, the responsibility for coordination of energy-related research activities within state government. In partial fulfillment of this responsibility the Montana Energy Office has compiled this Directory to provide a current inventory of all ongoing and recently completed (since 1974) energy-related research projects and programs which pertain to the State of Montana.

Objectives

Because of the increasing interest in the development of Montana's energy resources, the Montana Energy Office recognizes the need for greater accessibility to information about energy-related research activities. The goal of this Directory is to provide a useful information tool for researchers, state and local government planners and decisionmakers, and others involved in energy activities. By producing a comprehensive and up-to-date Directory of energy-related research, the Montana Energy Office hopes to: (1) facilitate communication among energy researchers in Montana; (2) reduce the amount of duplicative research; (3) provide funding agencies with a basis to consider funding of additional research; and, most important, (4) to see that research results are made available to all interested persons.

The Montana Energy Office also (1) maintains an "Energy Research Matrix Board," which is continuously updated, for quick reference to information on Montana energy research; (2) maintains research information files; and (3) provides a search and referral service for individuals who wish to obtain up-to-date information on the status of any project.

Compilation of the Directory

Numerous sources were consulted in the course of compiling this Directory. MEO staff contacted the research administration offices at the University of Montana, Montana State University, and the Montana College of Mineral Sciences and Technology, as well as individual researchers at these institutions. State and Federal agencies also provided input for the Directory, along with private research institutions and consulting firms. The Old West Regional Commission was especially helpful in the identification of federally-sponsored research projects. Newspapers and energy newsletters were also an important source of project information. Research information questionnaires were mailed to all individuals conducting energy-related research projects. In most cases, the descriptions of the research projects listed in the Directory are given as they appeared on the returned questionnaires.

Each research project that was identified by the Montana Energy Office staff was forwarded to the Old West Regional Commission for inclusion in their five-state computerized energy research information system. The Commission, in turn, forwarded these projects to the National Energy R and D Inventory at Oak Ridge National Laboratory where they are integrated into a national system of energy R and D.

Scope and Use of the Directory

The scope of this Directory is broad, covering a wide range of energy-related research. (See Table of Contents for a complete listing of research topics.) Each project is classified by primary category and listed only once in the Directory. Since many projects span more than one category, it is essential to scan several categories when searching for a particular type of project.

The Directory is indexed by investigator, organization (both funding agencies and research institutions), and subject (including geographic location). The indexes can be used to search the Directory for a subject of special interest.

Each project is numbered sequentially for convenience in using the indices. Each project contains the following information: project title (and contract number, if known), investigator(s), funding agency(ies), funding amount, duration, location, description, and publications. If a particular category of information does not appear, it is because the required information was not available by our press deadline.

While we recognize that this Directory is not an exhaustive inventory of energy-related research projects occurring in or for Montana, we have tried to make it as comprehensive as possible. If you know of energy-related research which should be incorporated in a revised and updated supplement to this Directory, we would appreciate receiving this information from you. In Appendix A of the Directory we have included a copy of MEO's research information questionnaire which you can use for this purpose. We would also appreciate knowing of any changes or corrections in project descriptions listed in the Directory. Any comments or suggestions that you may have on how we might improve this publication in the future will be greatly appreciated.

COAL

1.1 ATMOSPHERIC STUDIES

COAL/Atmospheric Studies

001

PROJECT TITLE: Air Quality Characterization at Four Sites Southeast of Colstrip, Montana

INVESTIGATORS/ORGANIZATION: J.D. Ludwick, L. Rancitelli, Radiological Sciences Dept., Battelle Pacific Northwest Labs., Richland, WA 99352

FUNDING AGENCY: U.S. Environmental Protection Agency, Corvallis Environmental Research Laboratory, Corvallis, OR

FUNDING AMOUNT: \$215,000

DURATION: 6/74 - 11/78

LOCATION: MT - Rosebud County (Hay Coulee, Kluver North, East and Southsites)

DESCRIPTION: The air monitoring characterization work is an integral component of the Montana coal-fired power plant project designed to determine the effects of emissions from coal-fired power plants on the surrounding environment. A mobile laboratory was installed at Hay Coulee, about seven miles southeast of the Colstrip plant location. Measurements of carbon monoxide, methane, nitric oxide, nitrogen dioxide, ozone, total sulfur, particulates, wind speed and direction are taken and recorded. Similar measurements will be made at Kluver, North, Kluver East, and Kluver West. Prior to 7/77 work was at the Hay Coulee site. (NOTE: This study is a sub-project of The Bioenvironmental Impact of a Coal-Fired Power Plant, Project No. 117.)

PUBLICATIONS: See The Bioenvironmental Impact of a Coal-Fired Power Plant, Second Interim Report, Colstrip, Montana, June 1975. (EPA-600/3-76-013)

002

PROJECT TITLE: Air Pollution Potential and Baseline Air Quality for Amax Coal Development in Montana

INVESTIGATOR/ORGANIZATION: James A. Heimbach, Jr., Earth Sciences Dept., Montana State Univ., Bozeman, MT 59715, (406) 994-3331

FUNDING AGENCY: Amax Coal Company

FUNDING AMOUNT: \$32,000

DURATION: 3/75 - 2/77 (Completed)

LOCATION: MT - Treasure and Big Horn Counties

DESCRIPTION: Amax Coal Company is planning to open a strip mine in Treasure and Big Horn Counties, Montana. In order that this facility may comply with State and Federal air pollution regulations, information on the pertinent meteorological factors to air pollution potential as well as baseline air quality data are needed in the initial stages and as the venture expands.

This project has four objectives: (1) to monitor for a one-year period the meteorological factors which are important in the evaluation of air pollution potential from ground-based sources; (2) to monitor for a one-year period the baseline air quality information pertinent to strip mining; (3) to derive the wind, precipitation, humidity, temperature and stability climatology for the one year of data and based on these, describe the air pollution potential for the area; and (4) to summarize the baseline air quality data in an

COAL/Atmospheric Studies

002 CONT.

easily usable format and relate to concurrent meteorological parameters of objective 1.

PUBLICATIONS: Final report to Amax Coal Company.

003

PROJECT TITLE: Air Quality Monitoring

INVESTIGATOR/ORGANIZATION: Robert E. Carroll, Ecological Consulting Service, 1300 Cedar, Helena, MT 59601, (406) 442-4650

FUNDING AGENCY: Peabody Coal Company, St. Louis, MO.

DURATION: 12/75 - Continuing LOCATION: MT - Rosebud County (Colstrip)

DESCRIPTION: Study to obtain ambient particulate loading, wind speed, and direction, and numerous other air quality data.

PUBLICATIONS: Periodic reports are filed with the Montana Dept. of State Lands and the U.S. Geological Survey.

004

PROJECT TITLE: Air Quality Monitoring at Colstrip, Montana

INVESTIGATOR/ORGANIZATION: R.J. Labrie, Montana Power Company, 40 E. Broadway, Butte, MT 59701, (406) 723-5421

FUNDING AGENCY: 50 percent Montana Power Co., 50 percent Puget Sound Power and Light

FUNDING AMOUNT: About \$11,000/year DURATION: Spring 1973-Continuing

LOCATION: MT - Rosebud County (Colstrip)

DESCRIPTION: A network of air quality sampling stations set up surrounding the Colstrip plant site, measuring SO₂, NO_x, particulates and flourides, using bubbler samplers, high-volume samplers, sulfation plates, flouride plates and dust-fall jars.

PUBLICATIONS: Data not reduced and summarized totally, but some data filed with the Mt. Dept. of Natural Resources and Conservation and the Montana Dept. of Health and Environmental Sciences.

005

PROJECT TITLE: Chronic Respiratory Disease and Lung Cancer Study

INVESTIGATOR/ORGANIZATION: Dennis Haddow, Air Quality Bureau, Mt. Dept. of Health and Environmental Sciences, Helena, MT 59601, (406) 449-3454

005 CONT.

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$22,981

DURATION: 11/76 - 7/77 (Completed)

LOCATION: MT - Especially Silver Bow and Deer Lodge Counties

DESCRIPTION: Montana's respiratory disease rate is higher than the national average. This study will look at causes of and mortality from respiratory disease in Montana, focusing on Silver Bow and Deer Lodge Counties. Causes will be related to existing industrial development. The potential impact of proposed energy development on respiratory disease will also be considered. The results from this study will be helpful in carrying out HB 250 (1977 Montana Legislature) -- an act to conduct a health effects and monitoring study of ambient air pollution concentrations in the Butte-Anaconda, Missoula, Billings, Columbia Falls, Hardin, Colstrip coal area and the East Helena area.

006

PROJECT TITLE: Cloud/Precipitation Modification Effects

INVESTIGATORS/ORGANIZATION: R.F. Pueschel, C.C. Van Valin, National Oceanic and Atmospheric Admin., ERL/APCL R31, Boulder, CO 80302, (303) 499-1000

FUNDING AGENCY: U.S. Environmental Protection Agency, Office of Research and Development

FUNDING AMOUNT: \$90,000

DURATION: 10/76 - 9/77 (Completed)

LOCATION: MT - Rosebud County (Hay Coulee field site near Colstrip)

DESCRIPTION: Objective - Develop criteria by which to assess the impact of increased use of sulfur-rich coals in power plants on the quality of the atmospheric environment, on nearby clouds and associated weather, and on local radiation budgets. In 1977 field measurements were conducted at the Hay Coulee field site near Colstrip during two periods of two weeks each. Measurements with an instrumented aircraft were done during these two study periods.

PUBLICATIONS: C.C. Van Valin and R.F. Pueschel. Atmospheric Aerosol Observations at Colstrip, Montana. Paper presented at the 4th Joint Conference on Sensing of Environmental Pollutants, New Orleans, LA, Nov. 10, 1977. During interim, copies are available from the authors.

007

PROJECT TITLE: Cloud and Precipitation Modification of Pollutants from Energy Production

INVESTIGATORS/ORGANIZATION: Rudolf Pueschel, Farn Parungo, Paul Allee, Charles Van Valin, U.S. National Oceanic and Atmospheric Admin., ERL, APCL R31, Boulder, CO 80302, (303) 499-1000

FUNDING AGENCY: U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration

COAL/Atmospheric Studies

007 CONT.

FUNDING AMOUNT: \$375,000 to date (FY77 - \$150,000)

DURATION: 5/75-10/79

LOCATION: MT - Rosebud County (near Colstrip), NM, UT, CA

DESCRIPTION: Objective - To develop criteria by which to assess the impact of increased use of sulfur-rich coals in power plants on the quality of the atmospheric environment, on nearby clouds and associated weather, and on local radiation budgets. Approach - Measurements are taken in and around plumes from power plants, petroleum refineries, and smelters to determine the size, shape, and chemical composition of atmospheric pollutants from the plants, especially gaseous and particulate sulfur and heavy metals compounds. Emphasis is on aerosols with cloud modifying properties. Since the gas-to-particle conversion rate and the size of the sulfuric acid and sulfate particles, hence their environmental impact, are functions of third-body trace constituents, water vapor mixing ratio, and ultra-violet irradiation, the field studies must be performed under different climatic conditions and in the absence and presence of independent pollution sources. Progress/Plans - Field studies have been conducted near Colstrip, MT., Farmington, NM, Magna, UT., and in the Los Angeles Basin, CA, providing measurements in clean air at these locations, as well as in plumes from coal-fired power plants, a copper smelter and a petroleum refinery, respectively. Plans call for three extended study periods during FY78, in which the instrumented research aircraft will be the primary means for data gathering at the Montana, New Mexico, and California sites.

PUBLICATIONS: Numerous. Contact investigators for availability.

008

PROJECT TITLE: Cost Benefit and Improved Fuel Use Through Time-Variable Atmospheric Dispersion Potential: An Assessment in Relation to Pollution Control

INVESTIGATOR/ORGANIZATION: Glenn R. Hilst, The Research Corporation, 125 Silas Deane Highway, Weathersfield, CT 06109, (203) 563-1431

FUNDING AGENCIES: Primary - U.S. National Science Foundation; Secondary - Electric Power Research Institute, Palo Alto, CA

FUNDING AMOUNT: \$240,000 (FY77 - \$90,000)

DURATION: 6/75 - 5/77 (Completed)

LOCATION: Nationwide; Phase I of project centered around Colstrip, Montana

DESCRIPTION: The purpose of this work is to evaluate the likelihood of using the natural dispersion property of the atmosphere for reducing air pollution from power plants. Specifically, the time variability of dispersion will be measured in order to design a program of fuel switching (high to low sulfur coal) and minimum use of control devices. By implementing such a program, money can be saved through less frequent operation of pollution control devices. Valuable low-sulfur coal can be used sparingly. The work will center around a power plant site at Colstrip, Montana. This is an area undergoing considerable expansion in mining and power generation activity. The project will entail:

- (1) Refining existing mathematical techniques for measuring dispersion

008 CONT.

variability; (2) Gathering existing meteorological data; (3) Analyzing the data to yield a dispersion pattern; and (4) Evaluating the efficacy of control devices in view of local dispersion characteristics.

PUBLICATIONS: Time-Variable Air Pollutant Emission Strategies for Individual Power Plants, Final Report, April 1977, prepared by TRC - The Research Corporation of New England. Available from EPRI or The Research Corporation.

009

PROJECT TITLE: Development of a Diffusion Model to Predict the Air Pollution Potential of Elevated Continuous Sources at Colstrip, Montana

INVESTIGATOR/ORGANIZATION: James A. Heimbach, Jr., Earth Science Dept., Montana State Univ., Bozeman, MT 59715, (406) 994-3331

FUNDING AGENCY: Montana Power Company, Butte, Montana

FUNDING AMOUNT: \$140,755 DURATION: 7/73 - 6/75 (Completed)

LOCATION: MT - Rosebud County (Colstrip)

DESCRIPTION: A diffusion experiment was conducted at Colstrip, Montana, to estimate the effects of the semi-rugged terrain on the dispersion of a plume from a large elevated source. The tracing techniques involved the continuous release of silver iodide from an effective height of 500 ft. above the general terrain and its subsequent tracking using airborne and ground-based NCAR acoustical ice nucleus counters.

The results show that the additional mechanical turbulence induced by the terrain plays a significant role in the dispersion of contaminants. The horizontal diffusion was larger than predicted by Turner's and Bowne's models at all downwind distances. The vertical diffusion over Colstrip compared favorably to Bowne's suburban parameterization and verified his reasoning that the vertical dispersion approaches a limit for large downwind distances. It was found that the horizontal and vertical diffusion rates were not well correlated. For this reason a dual model is recommended for the area which uses wind speed and lapse rate for predicting vertical diffusion, and wind speed and direction range for the horizontal.

PUBLICATIONS: Colstrip Diffusion Experiment, Final Report

010

PROJECT TITLE: Diffusion Modeling

INVESTIGATOR/ORGANIZATION: Arlan B. Super, Montana State Univ., Dept. of Earth Sciences, Bozeman, MT 59715

FUNDING AGENCY: The Montana Power Company, Butte, Montana

DURATION: 9/72 - 7/74 (Completed) LOCATION: MT - Rosebud Co. (Colstrip)

COAL/Atmospheric Studies

010 CONT.

DESCRIPTION: Development of a diffusion model for predicting air pollution potential under a range of weather conditions. This study will help determine stack heights for the Colstrip generating facility.

PUBLICATIONS: Diffusion Model to Predict Pollution at Colstrip Model - filed with the Mt. Dept. of Natural Resources, and the Mt. Dept. of Health and Environmental Sciences, Air Quality Bureau, and the Montana State Univ. Library.

011

PROJECT TITLE: Eastern Montana Air Quality Monitoring

INVESTIGATOR/ORGANIZATION: David Maughan, Air Quality Bureau, Mt. Dept. of Health and Environmental Sciences, Helena, MT 59601, (406) 449-3454

FUNDING AGENCIES: Primary - U.S. Environmental Protection Agency; Secondary - State of Montana

FUNDING AMOUNT: \$113,263 to date (FY77 - \$75,416 EPA, \$7,219 State share)

DURATION: 2/75 - Continuing

LOCATION: 11 locations in E. Montana

DESCRIPTION: Background levels of air quality are monitored at eleven locations in eastern Montana. Meteorological data is also obtained at some sites. Measurements are being made for sulfur dioxide, nitrogen dioxide, particulate matter, and trace elements. In addition, monitoring is being continued in the Colstrip area to assess the impact of the power plants.

PUBLICATIONS: The data is summarized annually and a report is published. The data is also stored in the data bank of the U.S. Environmental Protection Agency.

012

PROJECT TITLE: Fugitive Dust From Western Coal Mines (08-03-2477)

INVESTIGATOR/ORGANIZATION: John Garrett, Mathtech, Inc., P.O. Box 2392, Princeton, NJ 08540, (609) 799-2600

FUNDING AGENCY: U.S. Environmental Protection Agency, Cincinnati National Environmental Research Center

FUNDING AMOUNT: \$148,840

DURATION: 10/76 - 6/78

LOCATION: MT - Richland County (Savage), NM, WY, ND, CO

DESCRIPTION: The problem is to determine whether or not surface coal mines add significant amounts of fugitive dust to ambient dust levels in the west. The objectives of the project are to determine the levels of fugitive dust emitted by western surface coal mines, to assess the adequacy of existing dust control procedures, and if needed, to identify desirable modifications to these procedures. The approach will be to monitor upwind and downwind dust levels at four western surface mines under three different climatic conditions, and to use the field data in combination with applicable physical theory to develop and validate

012 CONT.

mathematical equations that relate fugitive dust levels to critical mining and meteorological parameters.

PUBLICATIONS: Final report due 6/30/78.

013

PROJECT TITLE: Ground-Level Measurements of Nuclei from Coal Development in the Northern Great Plains: Baseline Measurements

INVESTIGATOR/ORGANIZATION: Briant L. Davis, Institute of Atmospheric Science, So. Dakota School of Mines and Technology, Rapid City, SD 57701, (605) 394-2291

FUNDING AGENCIES: Primary - Old West Regional Commission; Secondary - U.S. Energy Research and Development Administration

FUNDING AMOUNT: \$162,750 (Old West); \$35,000 (ERDA)

DURATION: 6/76 - 6/78

LOCATION: MT, NE, ND, SD, WY

DESCRIPTION: The objectives of this research project are centered around the need for obtaining accurate meteorological and pollutant baseline measurements. These data may then be used by the grantee in a limited analysis under this project or by other more general research programs dealing with inadvertent weather modification as discussed below. Major objectives are summarized as follows: (1) To conduct monthly short-term (2 hour) and long-term (overnight) sampling in a five-state region which will provide data on particulates and gases for establishment of baseline concentrations levels; (2) To analyze data collected to estimate the particulate and gaseous concentrations in the observed effluent that have the potential to modify weather processes in the Northern Great Plains; (3) To make preliminary estimates and projections of future pollutant concentrations and their effects on weather processes in the impact area.

014

PROJECT TITLE: Ground Level Measurements of Nuclei From Coal Development in Northern Great Plains: Work Plans for Design of a Monitoring Program

INVESTIGATOR/ORGANIZATION: Briant L. Davis, Institute of Atmospheric Science, So. Dakota School of Mines and Technology, Rapid City, SD 57701, (605) 394-2291

FUNDING AGENCY: Old West Regional Commission

FUNDING AMOUNT: \$49,500

LOCATION: MT, ND, WY (No. Great Plains)

DURATION: 2/75 - 6/76 (Work on this contract was continued via Project No. 013.)

DESCRIPTION: The goal of this study is to prepare a technical and scientific foundation for obtaining particulate and gaseous emission information and its use in predicting or evaluating effects of such materials on the weather processes in the Northern Great Plains. The program goal leads toward an elimination of the uncertainty which now exists concerning the effect of numerous small particulates on rainfall or snowfall from cumulus or stratiform clouds.

COAL/Atmospheric Studies

014 CONT.

The ultimate results will be of value to the agricultural industry in states downwind from the coal development areas.

015

PROJECT TITLE: Integrated Aerosol Characterization Monitoring -- Colstrip, Montana

INVESTIGATORS/ORGANIZATION: G.T. McNice, R.F. Pueschal, V.E. Derr, U.S. National Oceanographic and Atmospheric Admin., 3100 Marine Ave., Boulder, CO 80302, (303) 499-1000

FUNDING AGENCY: U.S. Environmental Protection Agency, Corvallis Environmental Research Laboratory, Corvallis, OR

FUNDING AMOUNT: \$462,000 (FY77 - \$126,000) DURATION: 5/75 - 9/78

LOCATION: MT - Rosebud County (Hay Coulee site, 7 miles southeast of Colstrip)

DESCRIPTION: Aerosols contained in the power plant plume are monitored by the NOAA Aerosol Characterization Facility operating seven miles southeast of Colstrip at EPA's Hay Coulee site. Operation began in May of 1975, in order to establish a clear air baseline, and will continue for one month at the beginning and one month at the end of the growing season through 1978. During these periods aerosol concentrations are measured from ground level to 3000 feet altitude, and categorized by size, shape, elemental composition, and their efficiency as ice and cloud condensation nuclei. The results of the aerosol measurements are compared with changes in atmospheric turbidity, incoming solar radiation and heat radiation balance. Aerosol characterization information will be synthesized with the effects and gaseous characterization components of EPA NERL's Colstrip program to yield a protocol which planning managers can use in assessing the effects of coal-fired power plants on the environment. (NOTE: This is a sub-project of The Bioenvironmental Impact of a Coal-Fired Power Plant, Project No. 117.)

PUBLICATIONS: See The Bioenvironmental Impact of a Coal-Fired Power Plant, Second Interim Report, Colstrip, Montana -- June 1975 (EPA-600/3-76-013, February 1976).

016

PROJECT TITLE: Lidar Techniques for Measuring Particulate Pollutants from Energy Production and Their Transport and Dispersion Processes

INVESTIGATORS/ORGANIZATION: V.E. Derr, R.L. Schwiesdow, G.T. McNice, N.L. Abshire, G.M. Lerfald, M.J. Post, R.E. Cupp, R.F. Calfee, U.S. National Oceanic and Atmospheric Admin., Atmospheric Spectroscopy Program Area, R45X3, Boulder, CO 80302

FUNDING AGENCY: U.S. Dept. of Commerce, Nat'l. Oceanic and Atmospheric Admin.

FUNDING AMOUNT: \$245,000 (FY 76) DURATION: 7/75 - 7/80

016 CONT

LOCATION: MT - Rosebud Co. (field experiments at Colstrip), CO

DESCRIPTION: Objectives: Develop and verify economical lidar measurement techniques for remote tracing and analyzing of pollutants arising from power plants. Develop and test an operational, infrared, continuous-wave doppler lidar sensor for high resolution measurements of atmospheric wind, turbulence, and aerosol backscatter aspects of pollutant transport. Approach: We are extending the capabilities of the existing pulsed lidar to include polarization sensitivity and multiwavelength operation. This equipment is being used in field experiments at Colstrip, Montana and in various Colorado locations to test the plume characterization capability of the lidar. Experimental developments are guided by theoretical studies on aerosol backscatter properties. The WPL Mobile Doppler Lidar System is being applied to wind profile measurements in various environments and to the velocity structure of natural atmospheric vortices. Equipment modifications are underway to improve the lidar capability in stack emission measurements, three-component wind profiles, and large-diameter aerosol profiles. Progress: Lidar backscatter data on intensity and polarization from various natural and man-made atmospheric particles has been obtained in three different locations. Depolarization is a significant aerosol identifier. Theoretical calculations are underway. Doppler lidar 1-component wind profile measurements have been completed in desert, seacoast, and urban environments. Preliminary velocity data is available on cooling tower plumes and power plant stack-effluents.

017

PROJECT TITLE: Montana Air Pollution Study - I (MAPS-I)

INVESTIGATORS/ORGANIZATION: Michael Roach, Bob Raisch, Jim Gelhaus, Hal Robbins, Dave Maughan, Dennis Haddow, Mt. Dept. of Health and Environmental Sciences, Air Quality Bureau, Helena, MT 59601, (406) 449-3454

FUNDING AGENCY: Primary Sponsor -- State of Montana; Secondary Sponsor -- U.S. Environmental Protection Agency

FUNDING AMOUNT: \$1,070,000 (State of Montana); \$23,400 (EPA)

DURATION: 7/77 - 7/79

LOCATION: MT - Billings, Butte, Missoula, E. Helena, Hardin, Columbia Falls, Colstrip

DESCRIPTION: The Mt. Dept. of Health and Environmental Sciences is initiating a study under House Bill 250 to better define relationships between the health of Montana residents and air pollution. The study will generate the type of information needed to make sound decisions concerning the impacts of future community, industrial and resource development on human health.

The prospective study will investigate the correlation between respiratory irritation and levels of air pollution. It will focus on three areas of Montana: Butte-Anaconda, Missoula and the Billings coal development area. Important aspects of the study include: (1) researching the prevalence and severity of chronic obstructive pulmonary disease and lung cancer; (2) the monitoring of

COAL/Atmospheric Studies

017 CONT.

total suspended particulates, sulfur dioxide, sulfates and trace elements; (3) the collection of meteorological data to determine sources and concentrations of various pollutants, (4) updating the emission inventory to determine the amounts and sources of pollutants in different areas. The monitoring and meteorological programs will generate data that will allow the Department to determine the type, strength, duration and sources of air pollution levels.

018

PROJECT TITLE: Northern Great Plains Air Quality Data Gathering Network

INVESTIGATOR/ORGANIZATION: Jay Crawford, No. Dakota State Dept. of Health, Div. of Environmental Engineering, 1200 Missouri Ave., Bismarck, ND 58505, (701) 224-2348

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$61,216

DURATION: 9/74 - 10/76 (Each state is now operating their own monitoring stations.)

LOCATION: Eastern MT, Western ND, Northeastern WY, SD (No. Great Plains)

DESCRIPTION: Objective - To expand the previously existing data base for air quality information within the energy development area of W. No. Dakota.

Methodology - Installation of air quality monitoring equipment at seven new sites expanding the State Dept. of Health's data gathering network. Application of work - To aid the Dept. of Health and the U.S. EPA in decision-making policies regarding industrialization potentials in W. No. Dakota and in the No. Great Plains area. (E. Montana, W. No. Dakota, N.E. Wyoming).

PUBLICATIONS: Environmental Protection Agency No. Great Plains Ambient Air Monitoring Network, November 1975.

019

PROJECT TITLE: Northern Great Plains Wind Measurement Program

INVESTIGATOR/ORGANIZATION: R.E. Matkins, Ford Aerospace and Communications Corp., 214 N. 30th Street, Billings, MT 59101

FUNDING AGENCY: U.S. Environmental Protection Agency, Office of Research and Development

DURATION: 7/74 - 3/76 (Completed) LOCATION: MT, WY, ND (No. Great Plains)

DESCRIPTION: The objective of this project is to provide for the acquisition of upper air data (wind speed and wind direction at 30 meters) at three rural sites in Montana, Wyoming, and No. Dakota for a period of twelve months. Philco-Ford, the contractor will install and maintain the wind instrumentation, and collect and reduce the data recordings. The resulting daily wind information will be

019 CONT.

used by EPA in refining point source and pollutant diffusion models necessary for the prediction of air quality impacts of coal resource development.

PUBLICATIONS: Northern Great Plains Wind Measurement Program, Final Report to EPA.

020

PROJECT TITLE: Pilot Balloon Observations in the Northern Great Plains -- Temperature Soundings in the Northern Great Plains

INVESTIGATORS/ORGANIZATIONS: Western Scientific Services, 328 Airpark Drive, Ft. Collins, CO; Aeromet, P.O. Box FF, Norman, OK

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$32,000 DURATION: 6/75 - 7/76 (Completed)

LOCATION: MT - Rosebud County (Colstrip), No. Great Plains

DESCRIPTION: Upper air (to 6,000 feet) temperature and wind data are obtained at Colstrip for data input to air quality diffusion modeling. Twice a day every other day pilot balloon releases are made. A vertical temperature profile and wind speed and direction are obtained. Atmospheric stability categories are defined.

PUBLICATIONS: Raw and summary meteorological data available for inspection and copy at the U.S. EPA, 1860 Lincoln, Denver, CO 80203.

021

PROJECT TITLE: Pilot Scrubber Research for Colstrip Facility

INVESTIGATOR/ORGANIZATION: R.J. Labrie, The Montana Power Co., Butte, MT 59701, (406) 723-5421

FUNDING AGENCIES: The Montana Power Company; Combustion Equipment Associates

DURATION: 1/73 - 12/74 (Completed) LOCATION: MT - Rosebud Co. (Colstrip)

DESCRIPTION: The objective of this program was to develop an effective venturi scrubber to remove SO₂ and particulates in boiler generated flue gas from Colstrip coal. Pilot unit was tested at Corette.

PUBLICATIONS: Data from this program is available from the Mt. Dept. of Natural Resources, Helena, MT 59601.

022

PROJECT TITLE: Policy Evaluation Support for Air and Water Environments

COAL/Atmospheric Studies

022 CONT.

INVESTIGATORS/ORGANIZATION: Brian L. Murphy, Arthur Bass, J.R. Mahoney, Environmental Research and Technology, Inc., 696 Virginia Rd., Concord, MA 01742, (617) 861-6400

FUNDING AGENCIES: U.S. Federal Energy Administration, U.S. Environmental Protection Agency

FUNDING AMOUNT: Approx. \$30,000 (Part of a larger project.)

DURATION: 3/76 - 5/76 (Completed)

LOCATION: Western coal regions (as typified by N.W. Colorado)

DESCRIPTION: This project is a multi-task basic ordering agreement. The tasks to date include: (1) Evaluation of the impact of the significant deterioration proposals upon western surface coal mining operations; (2) Analysis of impact of significant deterioration amendments upon the siting of multiple industries; (3) Evaluation of the significant deterioration increments with respect to proposed synthetic fuel plants (coal gasification and oil shale recovery); (4) Evaluation of an air quality assessment methodology for power plant coal conversion. These studies are in support of a variety of policy planning and evaluation efforts presently underway within FEA and EPA.

PUBLICATIONS: Impact of Significant Deterioration Proposals Upon Western Surface Coal Mining Operations. Available from FEA. (Project No. CO-04-60460-00)

023

PROJECT TITLE: Poplar River Air Quality Studies

INVESTIGATOR/ORGANIZATION: James W. Gelhaus, Air Quality Bureau, Mt. Dept. of Health and Environmental Sciences, Helena, MT 59601, (406) 449-3454

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$76,500

DURATION: 2/77 - 2/78

LOCATION: MT - Valley, Roosevelt, Sheridan and Daniels Co. (Poplar River Basin)

DESCRIPTION: Background levels of various parameters will be made in the Poplar River area of Northeastern Montana prior to development of power plants across the border in Canada. Air quality measurements will be made for sulfur dioxide, nitrogen dioxide and particulate matter. Background concentrations of trace elements will be analyzed in the vegetation. Soil samples will also be collected and stored for future analysis. Coal samples from the Canadian coal mine will be analyzed for trace elements, sulfur, ash and various other properties. Measurements of various meteorological variables and visibility will also be made. (NOTE: This is part of EPA's Poplar River Study, No. 129.)

PUBLICATIONS: A report on each study will be made at the completion of the project and will be available from EPA. Monthly progress reports are available from the Montana Energy Office, State Capitol, Helena, MT 59601.

024

PROJECT TITLE: Precipitation Analysis, Colstrip, Montana

INVESTIGATOR/ORGANIZATION: Robert Carroll, Ecological Consulting Service, 1300 Cedar, Helena, MT 59601, (406) 442-4650

FUNDING AGENCY: Montana Power Company, Butte, Montana

DURATION: 1/73 - 12/75 (Completed) LOCATION: MT - Rosebud Co. (Colstrip)

DESCRIPTION: Baseline hydrogen ion (pH) determination and chemical change over time in the 10 x 20 area.

PUBLICATIONS: Report filed with the Mt. Dept. of State Lands and the Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

025

PROJECT TITLE: Program Development for Measurement of Erodibility of Spoil Banks and Untreated Topsoil Due to Wind Action. A Study of Particulate Matter Generated by Mining Operations

INVESTIGATOR/ORGANIZATION: William A. Hunt, Dept. of Civil Engineering and Engineering Mechanics, Montana State Univ., Bozeman, MT 59715, (406) 994-2111

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM)

FUNDING AMOUNT: \$9,500 LOCATION: MT - Rosebud Co. (Colstrip)

DURATION: 4/76 - 9/76 (Field work for this project has been completed. Project may be continued at some later date.)

DESCRIPTION: Objectives - A state-of-the-art assessment of methods for predicting the concentrations of airborne particulates originating with surface mining operations is to be made to investigate (a) the relative significance of this problem, (b) the methods currently used in preparing environmental impact statements predicting effects of airborne particulates, and (c) the value of improving the prediction methods. A summary of methods currently employed for minimizing the amount of airborne particulates generated at strip mining operations will be prepared.

PUBLICATIONS: A final report to the USDA, Forest Service, SEAM. It will be available from the Forestry Sciences Laboratory, Montana State University.

026

PROJECT TITLE: Study and Monitoring of Fort Union Basin -- Air Quality

INVESTIGATOR/ORGANIZATION: David Maughan, Air Quality Bureau, Mt. Dept. of Health and Environmental Sciences, Helena, MT 59601, (406) 449-3454

FUNDING AGENCY: U.S. Environmental Protection Agency

026 CONT.

FUNDING AMOUNT: \$72,176

DURATION: 2/75 - 6/76 (Completed)

LOCATION: MT - Rosebud Co. (Colstrip area)

DESCRIPTION: Background levels of air quality are monitored at two locations in the Colstrip area. Meteorological data is also obtained. SO_2 , NO_x , HC, TSP, O_3 , trace elements and fine particle measurements are being made. Data is collected, reduced, validated, and placed into a national data bank by the Mt. Dept. of Environmental Sciences.

PUBLICATIONS: James W. Gelhaus. An Air Quality Assessment of Colstrip, Montana Prior to Development of Coal-Fired Power Plants. January 1976. Available from the Montana State Library, Helena, MT 59601.

027

PROJECT TITLE: A Study of Power Plant Plumes to Determine Their Composition, Transport and Dispersion and Evaluate the Potential for Possible Modification of Weather on the Mesoscale

INVESTIGATORS/ORGANIZATION; John D. Marwitz, William A. Cooper, Dept. of Atmospheric Sciences, Univ. of Wyoming, Laramie, WY 82071, (307) 766-3245

FUNDING AGENCY: Old West Regional Commission

FUNDING AMOUNT: \$75,000

DURATION: 6/75 - 11/76 (Completed)

LOCATION: MT, ND, WY

DESCRIPTION: Objectives - (1) Observe the composition, transport and dispersion of plumes from large power plants under a variety of stability, wind shear and topographic conditions. (2) From these observations construct models of the horizontal and vertical transport and dispersion of the plumes. (3) Determine the possibilities of sensible heat, latent heat, cloud microphysics properties and radiation properties modifying the weather on the mesoscale. Observations of the plumes and their environment from three power plants for one week per plant in the winter. One coal-fired electrical power plant in the 500-1000 mw size now operating will be observed in each of the states of WY, MT, and ND. The research shall address the following major questions with the measurements obtained. (A) Is there a potential for significant weather modification resulting from the operation of power plants? (B) If so, under what conditions would this modification occur, and how serious would it be? (C) If there is a potential for weather modification, how can counter-measures be taken to minimize its effects?

PUBLICATIONS: Steven R. Hanna and Franklin Gifford. Meteorological Effects of Energy Dissipation at Large Power Parks. (In the Bulletin of the American Meteorological Society, Volume 56, No. 10, October 1975.) Also a final report to the Old West Regional Commission.

COAL

1.2 BIOLOGICAL

FISH AND WILDLIFE STUDIES

VEGETATION STUDIES

COMBINED WILDLIFE AND VEGETATION STUDIES

028

PROJECT TITLE: Adaptational Development and Prototype Implementation of an Operationally-Oriented, Computerized, Map-Based Data Storage and Analysis System for Fish and Wildlife Resource Management Use (WELUT No. 002-76)

INVESTIGATORS/ORGANIZATION: Douglas Mutter, George Nez, Larry Salmen, Federation of Rocky Mountain States, 2480 W. 26th Avenue, Suite 300B, Denver, CO 80211

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

FUNDING AMOUNT: \$414,600

DURATION: 9/76 - 10/78

LOCATION: MT, WY, CO

DESCRIPTION: The goal of this project is to develop, for use by the FWS Region 6, an operational capability to store in computerized files, and to analyze by computerized composite mapping, simulation and predictive modeling methods, data collected for use in resource development decisions requiring FWS inputs. This includes not only data that has, and will be, collected by FWS, but also includes development of the capability to access available computerized data files of other sources, especially other government natural resource management agencies. Numerous systems already exist for doing this sort of task. It is intended one or more existing systems will be modified to meet FWS needs. The basic function of such system is to obtain comprehensive land-use planning based on large data bases of map-based information.

PUBLICATIONS: There will be numerous products, including many reports. The basic product will be an in-house computerized natural resource information system designed to meet the needs of Region 6. Contact Ken Burnham, Project Officer, WELUT, U.S. Fish and Wildlife Service, Federal Bldg., Ft. Collins, CO 80521, for information on the availability of publications.

029

PROJECT TITLE: Aquatic Biological Inventory, Young's Creek Drainage, Big Horn Co.

INVESTIGATORS/ORGANIZATION: Dana C. Schmidt, Tom Olson, Olson-Elliott and Associates, P.O. Box 1209, 349 N. Main, Helena, MT 59601, (406) 443-5560

FUNDING AGENCY: Shell Oil Corporation, through Westech, Helena, Montana

DURATION: 6/75 - 1/78 (Completed)

LOCATION: MT -- Big Horn Co.(Tongue River, Young's Creek Drainage)

DESCRIPTION: The objective of this survey is to provide a complete premining inventory of the aquatic biology of the Young's Creek drainage areas that may be affected by future mining development. The data base developed includes data on invertebrate, periphyton, macrophyte, and fish communities.

PUBLICATIONS: Dana C. Schmidt and Thomas M. Olson. The Aquatic Invertebrate Fauna of a Small Eastern Montana Stream. 1977. In the Proceedings of the Montana Academy of Sciences, 36: 52-55. Final report submitted to Westech.

030

PROJECT TITLE: Aquatic Endangered Species (WELUT No. 024-76)

INVESTIGATOR/ORGANIZATION: Timothy Joseph, Ecology Consultants, Inc., P.O. Box 2150, Fort Collins, CO 80521

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

FUNDING AMOUNT: \$75,000 (Phase I) DURATION: 1/77 - 8/77 (Phase I)

LOCATION: MT, SD, ND, CO, IA (Upper Colorado and Missouri River Basins)

DESCRIPTION: The primary objective is an ecosystem study of the present status, distribution and habitat requirements of important endemic, endangered and threatened fishes of the Upper Colorado and Missouri Basins. The scope of this project is focused on the Colorado River Basin from Glen Canyon Dam upstream and the Missouri River Basin from Sioux City, IA upstream. Annotated and indexed bibliographies of all published and available unpublished technical information including current studies pertaining to aquatic fauna, flora, and habitat characteristics of the two river systems will be compiled. Project emphasis will be on endangered, threatened and selected endemic fish of the area, but all technical information pertinent to the river ecosystem and habitat characteristics of these fish will be included. A series of detailed study proposals for short-term studies will be prepared. The studies will be designed to fill specific data gaps concerning the distribution, ecology, and habitat requirements of target fish. Field studies based on the study proposals will be conducted following approval by the Project Officer.

PUBLICATIONS: Products will include: (1) An indexed and annotated bibliography of published and unpublished technical information regarding aquatic fauna of the Upper Colorado and Missouri River systems; (2) A set of maps and overlays for each river system delineating distribution, spawning and rearing area, physical and chemical characteristics and locations of past and present field studies; (3) An evaluation report of the ecosystem of the Upper Colorado River system based on the compiled data base; (4) A report on the habitat requirements of juvenile Colorado River squawfish; (5) A report on squawfish spawning behavior; and (6) Other reports as authorized in the future. Information on the availability of these publications may be obtained from the Project Officer, Harvey Doerksen, U.S. Fish and Wildlife Service, WELUT, Federal Bldg., Fort Collins, CO 80251.

031

PROJECT TITLE: Aquatic Environmental Analyses in the Lower Yellowstone River

INVESTIGATOR/ORGANIZATION: Patrick Graham and Larry G. Peterman, Mt. Dept. of Fish and Game, Box 430, Miles City, MT 59301, (406) 232-4365

FUNDING AGENCY: Primary - U.S. Dept. of the Interior, Bureau of Reclamation; Secondary - Colorado Interstate Gas

FUNDING AMOUNT: USDI - \$93,375 (FY77 \$43,375); CIG - \$10,000

DURATION: 4/74 - 3/78

031 CONT.

LOCATION: MT - Yellowstone River from Bighorn River to MT-ND state line

DESCRIPTION: Objectives - (1) Develop a rapid and accurate method for collecting stream profile cross sections in deep rivers. Profile data should be collected on at least one reach of a single channel, split channel, braided channel and immediately above and below a diversion structure; (2) Determine the effects of diversion structures at Forsyth and Intake on upstream migration of spawning fish; (3) Continue field life history studies begun under Contract No. 14-06-600-982A on life history and habitat requirements of walleye, sauger, channel catfish and burbot; and (4) Predict, based on data collected, the effects of altered flow regimes and associated diversion structures on aquatic populations of the lower Yellowstone.

PUBLICATIONS: Quarterly reports only available at this time.

032

PROJECT TITLE: A Bidding Game Survey Approach to the Estimation of the Value of Fish and Wildlife Resources in Seven Western States (WELUT No. 019-2-76)

INVESTIGATOR/ORGANIZATION: Ralph D'Arge, Resources and Environmental Economics Laboratory, University of Wyoming, Laramie, WY

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

FUNDING AMOUNT: \$129,479

DURATION: 10/76 - 8/78

LOCATION: MT, ND, ID, WY, CO, UT, NM

DESCRIPTION: The household production function approach (Project No.043) can produce highly accurate estimates of the value of wildlife in various outdoor activities, but it does not estimate the existence value associated with wildlife. The project will use a bidding-game survey to accomplish two purposes: (1) estimate the existence value which people place upon the wildlife resource; and (2) provide a check on the value estimates from Project No.043. The bidding-game survey, a complex technique, will determine what people are willing to pay for the enjoyment of the wildlife resource

PUBLICATIONS: Products will include (1) A preliminary survey form and sampling plan for the bidding game survey; (2) A final report detailing a bidding-game-survey method of wildlife valuation and estimates of wildlife values in the West based on the bidding-game survey. These reports will be available from the Project Officer, William King, U.S. Fish and Wildlife Service, WELUT, Federal Building, Ft. Collins, CO 80251.

033

PROJECT TITLE: Brophy Mine Wildlife and Wildlife Habitat Reconnaissance

INVESTIGATOR/ORGANIZATION: Robert Carroll, Ecological Consulting Service, 1300 Cedar, Helena, MT 59601, (406) 442-4650

033 CONT.

FUNDING AGENCY: Beartooth Coal Company

DURATION: 3/77 - 7/77 (Completed)

LOCATION: MT - Carbon County

DESCRIPTION: Beartooth Coal Company wildlife and wildlife habitat, and aquatic reconnaissance for the Brophy Mine near Red Lodge.

PUBLICATIONS: Reports are filed with the Montana Dept. of State Lands, Helena, MT.

034

PROJECT TITLE: Bull Mountains Coal Field Study

INVESTIGATOR/ORGANIZATION: Gary Dusek, Mt. Dept. of Fish and Game, Box 1123, Baker, MT 59313, (406) 778-3648

FUNDING AGENCY: State of Montana (Mt. Dept. of Fish and Game); Consolidation Coal Company

FUNDING AMOUNT: \$53,000 - Fish and Game; \$42,000 - Consolidation Coal

DURATION: 7/72 - 6/76 (Completed)

LOCATION: MT - Southern Musselshell and Northern Yellowstone Counties

DESCRIPTION: Objectives - (1) To determine the impact of surface mining upon the wildlife resources in the area; (2) To ensure that wildlife habitat values receive full recognition in any mining or reclamation effort; and (3) To investigate possible modifications or innovations in the reclamation process to avoid unnecessary loss of wildlife habitat.

PUBLICATIONS: Final report being prepared. Available from the Dept. of Fish and Game in early 1978.

035

PROJECT TITLE: Decision Processes (WELUT No. 029-76)

INVESTIGATOR/ORGANIZATION: Frank Graves, Institute of Public Administration, National Wildlife Federation, 1619 Massachusetts Ave. NW, Washington, D.C. 20036

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

FUNDING AMOUNT: \$68,259

DURATION: 6/76 - 1/77 (Completed)

LOCATION: MT, WY, ND, CO, UT, NM

DESCRIPTION: This project identified state and federal decision processes for leasing, for regulation and distribution of energy development, and for the allocation of water for energy and informational needs related to fish and wildlife resources. Emphasis is placed on major decision points, types and sources

035 CONT.

of information used at each decision point, and decision points in each process for which the Fish and Wildlife Service can provide information and the most appropriate format for such information.

PUBLICATIONS: Frank M. Graves, et. al. Energy, Public Choices, and Environmental Needs. Institute of Public Administration and National Wildlife Federation, Washington, D.C. March 1977. 61 pp. (FWS/OBS-77/04). NTIS Accn. No. PB 272 263 (PC:A07/MF:A01).

036

PROJECT TITLE: Decker-Birney Wildlife Study

INVESTIGATOR/ORGANIZATION: Steve Knapp, Mt. Dept. of Fish and Game, Box 584, Broadus, MT 59317, (406) 436-2261

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Land Management

FUNDING AMOUNT: \$40,000

DURATION: 8/74 - 6/76 (Completed)

LOCATION: MT -Portions of Big Horn, Powder River and Rosebud Counties

DESCRIPTION: Objectives - (1) To gather fish and wildlife resource information to fill the recognized needs of the Decker-Birney Study; and (2) To develop techniques to quantify wildlife resources, either directly or through habitat quality and population productivity indices.

PUBLICATIONS: Stephen J. Knapp. Birney-Decker Wildlife Study, Final Report. June 1977. 163 pp.

037

PROJECT TITLE: Distribution and Abundance of Breeding Birds on Surface-Mineable Coal Lands in the Northern Great Plains (WELUT No. 068-75)

INVESTIGATORS/ORGANIZATION: Joseph J. Hickey, Sharon A. Mikol, Department of Wildlife Ecology, University of Wisconsin, Madison, WI 53715, (406) 262-2671

FUNDING AGENCY: U.S. Department of Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

FUNDING AMOUNT: \$50,000 (Approx. \$20,000 in FY77)

DURATION: 7/75 - 6/78

LOCATION: No. Great Plains (Southeast MT)

DESCRIPTION: Objectives - (1) To calculate the breeding densities of non-game birds in major habitat types on coal-lease lands in southeast Montana; (2) To calculate similar densities on reclaimed spoil lands; (3) To relate these breeding-bird communities to vegetative parameters of the major habitat types; (4) To determine, if possible, what shortcuts will permit quick, simple transects to be used as meaningful indices of breeding densities in these habitats.

037 CONT

PUBLICATIONS: A final report will be prepared on the densities of breeding-birds, their habitat requirements, and an analysis of different census methods and census methodology modification recommendation.

038

PROJECT TITLE: East Decker Sage Grouse Study

INVESTIGATOR/ORGANIZATION: Steve Knapp, Mt. Dept. of Fish and Game, Box 584, Broadus, MT 59317, (406) 436-2261

FUNDING AGENCY: Decker Coal Company

FUNDING AMOUNT: \$5,225

DURATION: 6/75 - 7/76 (Completed)

LOCATION: MT -Big Horn County (East Decker)

DESCRIPTION: Objectives - (1) To determine brood rearing and wintering areas used by sage grouse from the East Decker strutting grounds; (2) To determine the numerical and spatial relationship of this segment of grouse to other segments which together make up a population unit; and (3) To propose a seasonal schedule of monitoring to permit assessment of change in location and/or numbers of grouse as a result of disruption of the strutting ground.

PUBLICATIONS: Final report to Decker Coal Company. September 1976.

039

PROJECT TITLE: Effects of Coal Extraction and Related Development on Wildlife Density (WELUT No. 045-76)

INVESTIGATOR/ORGANIZATION: Robert L. Phillips, U.S. Fish and Wildlife Service, Denver Wildlife Research Center, Bldg. 16, Federal Center, Denver CO80225

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

FUNDING AMOUNT: \$292,000 (FY 77 - \$153,000)

DURATION: 4/75 - 5/78 (Phase I)

LOCATION: Southeastern MT; WY (Shell Coal Lease Site, Sheridan Co.)

DESCRIPTION: The study will characterize selected wildlife habitats and determine the long-term effects of coal development on these habitats and related wildlife population responses. Basic population indices of selected wildlife species will be established prior to mining activities and following changes during and after the development period. The study is also designed to determine the effectiveness of land-reclamation procedures, measure and evaluate the significant habitat types on and near the study areas and determine how movement patterns of selected wildlife species are affected by mining and related activities.

039 CONT.

PUBLICATIONS: Products will include reports quantifying wildlife habitat requirements and showing how coal extraction and related development affect wildlife. Recommendations will be given on how mining plans can be altered to have the least detrimental effect on wildlife. Annual Progress Reports of the following work units now available are: (1) Effects of Coal Strip-mining on Habitat Use and Activity of Mule Deer; (2) Effects of Coal Strip-mining on Habitat Use Activities and Movement of Pronghorned Antelope; (3) The Effects of Coal Development on the Ecology of Birds of Prey in Southeastern Montana and Northern Wyoming; (4) Effects of Coal Stripmining on Habitat Use, Activities and Population Trends of Sharp-tailed Grouse. Contact Project Officer, Ken Burnham, U.S. Fish and Wildlife Service, WELUT, Fort Collins, CO 80521 for availability.

040

PROJECT TITLE: Effects of Coal-Fired Power Plant Emissions on Vertebrate Animals in Southeastern Montana

INVESTIGATORS/ORGANIZATION: Eric Preston and Martin L. Morton, Corvallis Environmental Research Laboratory, U.S. Environmental Protection Agency, 200 SW 35th Street, Corvallis, OR 97330, (503) 752-4211

FUNDING AGENCY: U.S. Environmental Protection Agency

DURATION: 6/74 - 6/79 LOCATION: MT - Rosebud County (near Colstrip)

DESCRIPTION: To address the overall goals of the Montana Coal-Fired Power Plant Project we are attempting to identify: (A) those populations of birds and mammals in the study area that are most sensitive to air pollution; (B) those species, systems, and functions that may serve as specific, "noise-free indicators of pollution; (C) population components that may serve as a measure of impact in the sense that they themselves are ecosystem resources or are coupled to ecosystem resources. We shall attempt to relate, if possible, functions of types B and C to evolve extrapolative or predictive models.

PUBLICATIONS: See The Bioenvironmental Impact of a Coal-Fired Power Plant, First Interim Report, December 1974, Second Interim Report, June 1975 (EPA-600/3-76-013)

041

PROJECT TITLE: Fisheries Investigations of the Yellowstone River, as Related to Water Quality Investigations of the Yellowstone River, Montana

INVESTIGATOR/ORGANIZATION: Larry Peterman, Mt. Dept. of Fish and Game, Box 430, Miles City, MT 59301, (406) 232-4365

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey

FUNDING AMOUNT: \$35,758 DURATION: 4/76 - 6/77 (Completed)

LOCATION: MT - Lower Yellowstone River

041 CONT.

DESCRIPTION: This study will complement an existing fisheries study being conducted by the Mt. Dept. of Fish and Game on the lower Yellowstone River. This study, along with the water quality, invertebrate, furbearer, waterfowl and other aquatic studies previously mentioned, will aid in attaining a better understanding of the total Yellowstone River ecosystem. This information will help forecast the consequences of proposed developments and will help formulate a water management plan to protect the stream for biological needs

042

PROJECT TITLE: Habitat Requirements and Locations of Spawning and Nursery Areas in the East Poplar River, Montana

INVESTIGATOR/ORGANIZATION: Robert Needham, Mt. Dept. of Fish and Game, Helena, MT 59601

FUNDING AGENCY: U.S. Environmental Protection Agency (through the Mt. Dept. of Health and Environmental Sciences)

FUNDING AMOUNT: \$6,771

DURATION: 5/75 - 6/76 (Completed)

LOCATION: MT - East Poplar River

DESCRIPTION: Coal mining, development of power generating plant and dam construction on, or adjacent to, the Poplar River in Canada could affect lower segments of the Poplar River in Montana. In conjunction with water quality studies an intensive investigation of the biotic resources of the East Poplar River are being conducted. Fisheries studies are to be initiated to determine relative abundance, distribution, nursery and spawning areas, habitat requirements and species composition.

PUBLICATIONS: Mimeod final report submitted by the Dept. of Fish and Game to the Mt. Dept. of Health and Environmental Sciences, Helena, MT 59601.

043

PROJECT TITLE: A Household Production Function Approach to the Estimation of the Value of Fish and Wildlife Resources in the Seven Western States (WELUT No. 019.1-76)

INVESTIGATOR/ORGANIZATION: Thomas Crocker, Resource and Environmental Economics Laboratory, University of Wyoming, Laramie, WY

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

FUNDING AMOUNT: \$126,106

DURATION: 10/76 - 8/78

LOCATION: MT, ND, WY, ID, CO, UT, NM

DESCRIPTION: The lack of adequate estimates of the economic value of wildlife places wildlife resources at a disadvantage in certain governmental planning

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processes. The project will estimate the economic value of wildlife using the recently developed household production function approach to valuation of environmental characteristics. The household production function approach is based on the notion that families use inputs such as wildlife to produce a desired experience such as a hunting trip or a camping trip to a wildlife-rich region.

PUBLICATIONS: Products will include (1) A preliminary survey form and sampling plan for the household production function survey; (2) A final report detailing the method of wildlife valuation producing the most accurate estimate of present wildlife values, estimates of wildlife values, and expenditure data to be used in estimating impacts on regional economies caused by increase or decline in wildlife populations. Contact the Project Officer, William King, Fish and Wildlife Service, WELUT, Federal Bldg., Fort Collins, CO 80521 for availability.

044

PROJECT TITLE: Impact of Energy Development on the Wildlife of Northwestern Wyoming, Northwestern South Dakota, and Southeastern Montana

INVESTIGATOR/ORGANIZATION: Frank Schitoskey, South Dakota State Univ. Fish and Wildlife Cooperative Unit, Brookings, SD 57006, (605) 688-6121

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Office of Biological Services

FUNDING AMOUNT: \$175,000

LOCATION: MT, WY, SD

DURATION: 7/75 - 6/79 (Montana portion of this study was terminated in 1976.)

DESCRIPTION: Develop baseline information and methodologies to assess regional impacts of coal processing. This study, conducted in Wyoming, Montana, and South Dakota, will develop a simulation model of wildlife and energy dynamics of a short prairie eco-system.

045

PROJECT TITLE: Instream-Flow Strategies (WELUT No. 023-76)

INVESTIGATORS/ORGANIZATIONS: Richard Dewsnap and Dallin Jensen, Dewsnap and Jensen, Salt Lake City, UT; Wayne Nelson, Enviro Control, Inc., Rockville, MD

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

FUNDING AMOUNT: \$117,645

DURATION: 8/76 - 1/78

LOCATION: Western states

DESCRIPTION: The study will identify all existing procedural, methodological, and legal means for reserving flows for enhancing fish and wildlife purposes and evaluate the effectiveness of these means for reserving flows as tools for

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use by state and/or federal fish and wildlife agencies. In addition, the study is designed to determine the extent of unobligated waters in federal reservoirs and the extent to which such waters may be available to ensure downstream flows for fish and wildlife.

PUBLICATIONS: (1) Dewsnap, R.L., D.W. Jensen. Strategies for Reserving Flows for Fish and Wildlife: Identification, Description, and Preliminary Evaluation. Dewsnap and Jensen, Salt Lake City, UT. February 1977. 706 pp. (FWS/OBS-77/26). (2) Dewsnap, R.L., and D.W. Jensen. State Laws and Instream Flows. Dewsnap and Jensen, Salt Lake City, UT. March 1977. 76 pp. (FWS/OBS-77/27).

A matrix will also be prepared for each western state summarizing pertinent information for each strategy of reserving flows. The matrices will include: legal basis for the strategy; administrative procedures and decision points for implementing it; costs; typical problems and constraints; estimate of usability and who can utilize the strategies.

046

PROJECT TITLE: Investigations of the Effects of Coal-Fired Power Plant Emissions Upon Insects

INVESTIGATOR/ORGANIZATION: Jerry J. Bromenshenk, Department of Botany, Univ. of Montana, Missoula, MT 59801, (406) 243-5648

FUNDING AGENCY: U.S. Environmental Protection Agency, Corvallis Environmental Research Laboratory, Corvallis, OR

DURATION: 8/74 - 9/79

LOCATION: MT - Rosebud Co. (Colstrip area)

DESCRIPTION: The insect studies should contribute to an understanding of the plant-insect-fungal relations of both the grassland and forest ecosystems of southeastern Montana. This on the responses of pollinators to air pollution stress should be invaluable to the other studies being conducted on plant diversity, plant productivity, and energy flow relations. This study contributes information about insect population trends, behavior, and physiology, as well as following pathways of air pollutants through an insect system: honeybees. (NOTE: This study is a sub-project of Investigations of the Bioenvironmental Impact of Fossil Fuel Power Plants in the Fort Union Basin of Montana, Project No. 103.)

PUBLICATIONS: See The Bioenvironmental Impact of a Coal-Fired Power Plant, First Interim Report, December 1974, Second Interim Report, June 1975 (EPA-600-3-76-013).

047

PROJECT TITLE: Investigations of the Implications of Yellowstone River Flow Reservations, Montana

INVESTIGATOR/ORGANIZATION: Larry G. Peterman, Mt. Dept. of Fish and Game, Box 430, Miles City, MT 59301, (406) 232-4365

047 CONT.

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service

FUNDING AMOUNT: \$100,000

DURATION: 7/75 - 6/78

LOCATION: MT - Treasure, Rosebud, Custer, Prairie, Dawson, Richland Counties (Yellowstone River from mouth of Bighorn River to MT-ND state line)

DESCRIPTION: Objectives - (1) To correlate and supplement the baseline data obtained from the various studies and other available information and to assess the impacts where sufficient data exists of various assumed river flow regimes on the components of the natural biological system; (2) To develop instream flow requirements for the stream system and to support an appropriate application for reservation of flows under terms of the applicable state statute; (3) To evaluate the adequacy of the three-year moratorium period for obtaining the necessary baseline data and to analyze the effectiveness of this project approach in accomplishing objectives 1 and 2; and (4) To assemble all data, analyses and conclusions in a manner suitable for use in future analyses related to anticipated alternative water development and use studies

PUBLICATIONS: Several quarterly reports submitted to the Fish & Wildlife Service.

048

PROJECT TITLE: Lower Yellowstone Aquatic Invertebrate and Forage Fish Study

INVESTIGATOR/ORGANIZATION: Robert Newell, Mt. Dept. of Fish and Game, Glendive, MT

FUNDING AGENCY: Intake Water Company, Houston, TX

FUNDING AMOUNT: \$50,000

DURATION: 8/74 - 8/76 (Completed)

LOCATION: MT - Lower Yellowstone River

DESCRIPTION: Objectives - (1) Inventory aquatic invertebrates and forage fish supporting major fish populations in the lower Yellowstone River; and (2) Assess potential effects of reduced river flows on aquatic invertebrates.

PUBLICATIONS: Robert L. Newell. Yellowstone River Study, Final Report. 259 pp. Available from the Montana State Library, Helena, MT 59601.

049

PROJECT TITLE: Lower Yellowstone River Furbearer Study

INVESTIGATOR/ORGANIZATION: Peter Martin, Mt. Dept. of Fish and Game, Box 1017, Forsyth, MT 59327, (406) 356-2611

FUNDING AGENCY: Old West Regional Commission (through the Mt. Dept. of Natural Resources and Conservation, Helena, MT

FUNDING AMOUNT: \$9,226

DURATION: 8/74 - 12/76 (Completed)

049 CONT.

LOCATION: MT - Lower Yellowstone River

DESCRIPTION: Objectives - (1) Inventory furbearers and associated habitat types along the lower Yellowstone River; and (2) Assess impact of altered streamflows on furbearer populations.

PUBLICATIONS: A technical report on this study will be published by the Mt. Dept. of Natural Resources and Conservation in late 1977.

050

PROJECT TITLE: Northern Great Plains Breeding-Bird Survey (WELUT No. 047-75)

INVESTIGATOR/ORGANIZATION: Harold A. Kantrud, No. Prairie Wildlife Research Center, Box 1747, Jamestown, ND

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

FUNDING AMOUNT: \$611,140

LOCATION: MT, WY, SD, ND, MN

DURATION: 5/75 - 9/77 (phase I), 9/79 (phase II)

DESCRIPTION: The project is an ongoing preliminary effort to (1) develop a satisfactory, realistic classification of grassland biotic communities on the Northern Great Plains of North America (including the prairie regions of Alberta, Saskatchewan, Manitoba, Montana, and North Dakota, and portions of Wyoming, South Dakota, and Minnesota), and (2) to assess the use made of each prairie grassland community type by breeding-bird populations. The study will be modified during this FY to select and modify a classification system jointly with the Habitat Assessment Group, and to design, plan, and initiate cooperative studies (with other FWS research elements) to quantify the distribution and abundance and rates of change of natural and altered ecosystems in the NGP to characterize these ecosystems as to the productivity and importance to the maintenance of avian populations, and develop models to predict the impact of habitat changes on the diversity and production of avian populations in the NGP.

PUBLICATIONS: Products in Phase I will include a report of (a) location of tracts of native prairie of 40 acres or more, and (b) grassland classification system based on the Aandahl soil based classification system. Products in Phase II will include (a) a catalogue of native grassland areas, and (2) a classification of native grassland communities. Contact the Project Officer, James Roelle, Fish and Wildlife Service, WELUT, Federal Building, Fort Collins, CO 80521 for availability.

051

PROJECT TITLE: A Northern Pike Spawning Marsh and Waterfowl Nesting Area Using Effluent Water From a Surface Coal Mine (WELUT No. 028.2-76)

INVESTIGATOR/ORGANIZATION: Richard W. Gregory, Montana Cooperative Fishery Research Unit, Montana State Univ., Bozeman, MT 59715, (406) 994-2450

051 CONT.

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

FUNDING AMOUNT: \$80,180

DURATION: 9/76 - 4/79

LOCATION: MT - Big Horn County (Decker)

DESCRIPTION: Project Objective - Conduct a field demonstration and verification of a habitat enhancement technique at Decker, Montana using settling (sedimentation) pond decant water to develop a northern pike spawning and waterfowl nesting marsh. Tasks - (1) To conduct fertilization and hatching experiments with northern pike eggs in Decker Coal Mine effluent waters; (2) To modify an existing basin into a controlled, northern pike spawning marsh and include 8-10 waterfowl nesting islands in the construction; (3) To capture and plant sexually mature northern pike in the spawning marsh; and (4) To monitor development, hatching success and survival of fry and fingerling pike in the marsh. To monitor waterfowl production and aquatic mammal use on the marsh.

PUBLICATIONS: R.W. Gregory. Furbearer Survey, Interim Report. Unpublished March 1977. 24 pp. (WELUT-77/03). Available from the Project Officer, Lee Ischinger, U.S. Fish and Wildlife Service, WELUT, Federal Building, Fort Collins, CO 80521.

Products will also include an operationally oriented, step-by-step handbook detailing the methods and techniques developed in this study as well as the application and limitations of the results to other coal developments in the Northern Great Plains.

052

PROJECT TITLE: Poplar River Aquatic Studies (EPA No. WT 6-99-05455)

INVESTIGATOR/ORGANIZATION: Phil Stewart, Mt. Dept. of Fish and Game, Helena, MT 59601

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$2,500

DURATION: 9/76 - 2/77 (Completed)

LOCATION: MT - Poplar River

DESCRIPTION: The objective of this study will be to identify spawning and nursery areas and quantify production of important sport fishes in the Poplar River. The Saskatchewan Power Corporation is presently developing a coal-fired generation complex on the East Poplar River. Construction of a cooling reservoir was initiated in 1975 and impoundment of run-off water began in the Spring of 1976. This project will greatly reduce flows and alter flow regimens in the East Poplar River. Flows in the Middle and West Poplar River may also be affected in the future, since diversions to the East Fork are anticipated for supplemental water. Coincident with flow reductions, significant degradation of water quality has been forecast as a result of natural and forced evaporation at the East Poplar cooling reservoir. This is particularly significant, since it is believed that conditions necessary to maintain key sport fishes are presently marginal.

053

PROJECT TITLE: Poplar River Fish and Furbearer Impact Studies

INVESTIGATOR/ORGANIZATION: Jim Posewitz, Ecological Services Div., Mt. Dept. of Fish and Game, Helena, MT 59601, (406) 449-2603

FUNDING AGENCY: U.S. Environmental Protection Agency (through the Montana Energy Office)

FUNDING AMOUNT: \$20,000

DURATION: 1/77 - 12/77

LOCATION: MT - Poplar River

DESCRIPTION: The objectives of this project are to (1) Identify both fish and wildlife species dependent upon the Poplar River; (2) Determine the life history requirements of the key fish and wildlife populations now found in and along the Poplar River; (3) Describe the habitat characteristics critical to meeting the ecological requirements of key fish and wildlife species; (4) Relate this ecological information to changes effected by the power plant complex development and predictable alterations that would occur with expanded water consumption. The work will be divided into a fisheries project, a waterfowl project, and a furbearer project, with all three project segments making a contribution to the understanding of nongame wildlife species also dependent upon this particular system. (NOTE: This study is a sub-project of EPA's Poplar River Study, Project No. 129.)

PUBLICATIONS: A report on this study will be made at the completion of the project and will be available from EPA. Monthly progress reports are available from the Montana Energy Office, State Capitol, Helena, MT 59601.

054

PROJECT TITLE: The Potential Impact of Coal Strip Mining on the Wildlife Resources of Sarpy Creek Drainage, MT

INVESTIGATORS/ORGANIZATION: Richard Gregory, Harold Picton, Robert Moore, Robert Eng, Cooperative Fishery Research Unit, Dept. of Biology, Montana State Univ., Bozeman, MT 59715, (406) 994-2450

FUNDING AGENCY: Amax Coal Company

FUNDING AMOUNT: \$57,797 (FY77 - \$13,187)

DURATION: 3/75 - 6/77

LOCATION: MT - Sarpy Creek Drainage

DESCRIPTION: Major objectives only. Bird Segment - (1) Determine species composition of birds by vegetational type; (2) Measure density of birds in principal vegetational type; (3) Estimate population and distribution of major game bird species. Large Mammal Segment - (1) Map and classify vegetation in study area; (2) Determine large mammal species, population size and type, location, and season of use of area vegetational types; (3) Estimate current and potential wildlife use by humans in the area; (4) Estimate effects of large mammal species on attempts to re-vegetate mined lands. Small Mammal Segment - (1) Determine species composition of small mammals by vegetation types; (2)

054 CONT.

Estimate population sizes of small mammals in principal vegetation types.

Fish Segment - (1) Map stream morphometry of Sarpy Creek; (2) Determine species composition, standing crop and distribution of fishes; (3) Estimate use patterns of fishes migrating from the Yellowstone; (4) Qualify occurrence and distribution of stream benthos; (5) Estimate fisherman use of area. All Segments - To predict effects of coal strip mining on all of the above.

PUBLICATIONS: This study will result in the publication of a thesis.

055

PROJECT TITLE: Prairie Dog Town Mapping, McCone County, Color-Infrared Photo Interpretation

INVESTIGATORS/ORGANIZATION: Tom Olson, Gerald Moore, Olson-Elliott & Associates, P.O. Box 1209, 349 N. Main, Helena, MT 59601, (406) 443-5560

FUNDING AGENCY: State of Montana (Mt. Dept. of Livestock)

FUNDING AMOUNT: \$1,140 DURATION: 5/77 - 6/77 (Completed)

LOCATION: MT - McCone County (Circle West Project study area)

DESCRIPTION: This project involved preparation of a map overlay and acreage determinations for Prairie Dog Towns in McCone County, MT. This exercise was completed using available black and white and color-infrared photography. The site of this project is in the Circle West Project study area.

PUBLICATIONS: Data and map submitted to the Mt. Dept. of Livestock, Helena, MT.

056

PROJECT TITLE: Predicted Impact of Coal Development on the Fishery Resources of the Tongue River Reservoir, Montana

INVESTIGATORS/ORGANIZATION: Richard W. Gregory, R. Penkal, Cooperative Fishery Research Unit, Montana State Univ., Bozeman, MT 59715, (406) 994-2450

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$21,400 (FY77 - \$5,400) DURATION: 7/75 - 7/77

LOCATION: MT - Big Horn County (Tongue River Reservoir)

DESCRIPTION: Objectives - (1) To measure standing crop, reproductive success, and growth rates of major sport fishes in the Tongue River Reservoir; (2) To correlate fish population parameters with current limnological conditions in the reservoir and upstream portions of the river influencing sport fish production (including settling pond drainage); (3) To predict impact of changes in water use patterns on sport fish production in the reservoir. With these data we hope to predict impact of future coal development and possible changes in water use patterns on sport fish production in the reservoir.

057

PROJECT TITLE: Ranking of Wildlife Values on Federal Coal Lands

INVESTIGATOR/ORGANIZATION: Jim Wambaugh, Mt. Dept. of Fish and Game, Box 313, Fort Peck, MT 59223, (406) 526-3584

FUNDING AGENCY: U.S. Dept. of the Interior, Fish and Wildlife Service, Office of Biological Services

FUNDING AMOUNT: \$25,580

DURATION: 4/76 - 9/77

LOCATION: MT (Federally owned coal lands)

DESCRIPTION: Project objective - To rank the terrestrial wildlife values of land underlain by Federal coal, and to use these rankings to draft nominations for or against leasing. Early identification of wildlife values will provide resource managers and industry with information which may help in their decision-making process. Assembly of a standardized ranking of wildlife values by recognized experts will provide substantiated data to state and local governments, to the environmental community, and to the public.

058

PROJECT TITLE: Scenarios for Utilizing Process and Mine Waters for Aquatic Habitat Enhancement (WELUT No. 028.1-77)

INVESTIGATOR/ORGANIZATION: John C. Hutchins, Skelly and Loy, Inc., 2601 N. Front St., Harrisburg, PA 17110

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

FUNDING AMOUNT: \$47,940

DURATION: 5/77 - 2/78

LOCATION: MT (part of Crow Indian Reservation and Powder River County), ND, WY, CO, UT, NM

DESCRIPTION: This project will develop a "state-of-the-art" manual detailing existing and promising methods and strategies related to the utilization of western coal-mine and mine-mouth conversion plant waste waters for fish and wildlife habitat enhancement.

PUBLICATIONS: Products will include: (1) A state-of-the-art manual including A) an annotated bibliography describing existing technology and practices regarding the utilization of process and mine waters for habitat development or enhancement, B) scenarios representative of surface and underground mining, coal-fired steam-electric generating stations, and coal gasification. The scenarios will include the construction of composite mass water balances for each waste water source, C) habitat development/enhancement scenarios, D) practical and innovative waste-water strategies for each scenario.

059

PROJECT TITLE: Sharptailed Grouse Research with Montana Fish and Game, Colstrip, Montana

INVESTIGATOR/ORGANIZATION: Robert E. Carroll, Ecological Consulting Service, 1300 Cedar, Helena, MT 59601, (406) 442-4650

FUNDING AGENCY: Montana Power Company. In 1976 the funding shifted to Western Energy Company.

DURATION: 4/75 - Continuing LOCATION: MT - Rosebud Co. (Colstrip)

DESCRIPTION: Research between Montana Power Company and Western Energy Company assisted by the Montana Dept. of Fish and Game to recreate sharptailed grouse breeding grounds in reclaimed lands.

PUBLICATIONS: Annual progress reports to the Montana Power Company.

060

PROJECT TITLE: A Simulation Approach to the Analysis of Strip-Mining Impact on the Ecosystem with Emphasis on Wildlife (WELUT No. 013.1-76)

INVESTIGATORS/ORGANIZATION: James E. Ellis and William J. Parton, Natural Resource Ecology Lab., Colorado State Univ., Fort Collins, CO 80523

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

FUNDING AMOUNT: \$77,572 DURATION: 9/76 - 1/78

LOCATION: MT, WY, ND, SD (No. Great Plains)

DESCRIPTION: This project will develop a simulation model capable of replicating the response of the perturbed ecosystem to alternative rehabilitation strategies over a 10-year period. The study will include an extensive compilation of pertinent literature, a series of model experiments (simulation gaming) and modification and redevelopment of the existing ecosystem simulation model by sensitivity analysis and by comparison of model prediction to real field data.

PUBLICATIONS: S. Ralston, D. Hilbert, D. Swift, B. Carlson, and L. Menges. The Ecological Effects of Coal Strip-Mining: A Bibliography with Abstracts. Natural Resource Ecology Laboratory, Colorado State Univ., Fort Collins, CO. March 1977. 416 pp. (FWS/OBS-77/09). NTIS Accn. No. PB 265 316/AS (PC:A18/MF:A01).

Products will also include: (1) A local effects model simulating alternative rehabilitation strategies; and (2) A users manual documenting the model.

061

PROJECT TITLE: State-of-the-Art Review of Reclamation of Western Wildlife Habitats (WELUT No. 031-76)

INVESTIGATOR/ORGANIZATION: Cyrus M. McKell, Utah State Univ. Foundation, Institute of Land Rehabilitation, Logan, UT 84321

061 CONT.

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

FUNDING AMOUNT: \$49,000

DURATION: 7/76 - 5/77 (Completed)

LOCATION: MT, WY, ND, SD, UT, CO, AZ, NM

DESCRIPTION: This project is designed to review literature and research and make recommendations and provide the necessary guidelines and information to managers making revegetation, rehabilitation, and reclamation decisions concerning disturbed wildlands and altered wildlife habitats.

PUBLICATIONS: Products - (1) A review of state-of-the-art rehabilitation of western wildlife habitats; (2) An annotated bibliography of rehabilitation of western wildlife habitats; (3) A listing of past, present, and planned research in rehabilitation of western wildlife habitats. Contact the Project Officer, Phil Dittberner, U.S. Fish and Wildlife Service, WELUT, Federal Bldg., Fort Collins, CO 80521, for availability.

062

PROJECT TITLE: Stream Classification

INVESTIGATOR/ORGANIZATION: George D. Holton, Mt. Dept. of Fish and Game, Helena, MT 59601, (406) 449-2448

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service

FUNDING AMOUNT: \$31,395

DURATION: 12/76 - 6/78

LOCATION: MT (All of the streams in Montana)

DESCRIPTION: This program will consist of establishing criteria for classifying streams into four classes depicting their fishery value. Data relating to these criteria will be documented for each of the estimated 1,000 to 1,500 stream reaches in the Yellowstone River Drainage. As there will not be time for field investigations of streams, the data for evaluation will have to come from the Department files in Helena and field offices and from consultation with fisheries workers familiar with the waters. The value classification of each reach will be determined from an Evaluation Criteria Matrix. In addition, the value classification for each stream reach will be encoded on U.S. Geological Survey 1:250,000 maps. (NOTE: This study was recently expanded to include classification of all of the streams in Montana.)

063

PROJECT TITLE: Surface Mining Effects and Stipulations Manuals (WELUT No. 010-76)

INVESTIGATORS/ORGANIZATIONS: Russell Moore, Ecology Consultants, Box 2105, Fort Collins, CO 80521; Hittman Associates, Inc., Columbia, MD

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

063 CONT.

FUNDING AMOUNT: \$150,000

DURATION: 1/77 - 10/77 (Completed)

LOCATION: MT (part of the Crow Indian Reservation and Powder River Co.), ND, CO, UT, NM, WY

DESCRIPTION: This project will summarize surface mining technology and activities and the related physical, chemical and biological impacts in the Western United States. A handbook for each of three western geomorphic regions (Northern Great Plains, Rocky Mountain and Arid Southwest) will be prepared summarizing surface mining impacts, recommended environmental stipulations, and a flow diagram indicating when and where control stipulations can be introduced to benefit fish and wildlife.

PUBLICATIONS: R. Moore. An Environmental Guide to Western Surface Mining. Part One: Federal Leasable and Locatable Mineral Regulations. Ecology Consultants, Inc., Fort Collins, CO. June 1977. 67 pp. (FWS/OBS-77/20). L.C. No. 77-82534, NTIS Accn. No. PB 272 153 (PC:A05/MF:A01).

Products will also include three separately bound manuals which discuss fish and wildlife problems associated with surface mining in: (1) The Intermountain Region, (2) The Great Plains Region, and (3) The Southwest Region. Contact Lee Ischinger, Project Officer, U.S. Fish and Wildlife Service, WELUT, Federal Building, Fort Collins, CO 80521 for availability.

064

PROJECT TITLE: Survey of Existing Conditions Below Dams and Diversions in the West (WELUT No. 049-75)

INVESTIGATORS/ORGANIZATIONS: Wayne Nelson, Enviro-Control, Inc., 11300 Rockville Pike, Rockville, MD 20852; Charles Hazel, Jones and Stokes Assoc., Inc., 2321 P Street, Sacramento, CA 95814

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

FUNDING AMOUNT: \$202,611 (\$142,165 Enviro-Control; \$60,446 Jones and Stokes)

DURATION: 7/75 - 9/76 (Completed)

LOCATION: 149 dams in California, Pacific Northwest, and Rocky Mountains

DESCRIPTION: This project was a post-audit of approximately 100 dams and diversions to identify the instream-flow needs methodology used by the biologist, institutional cooperation and/or constraints in the implementation phase, and the actual impact of altered flows on fish and wildlife.

PUBLICATIONS: Assessment of Effects of Altered Stream Flow Characteristics on Fish and Wildlife. Part A: Rocky Mountains and Pacific Northwest. Executive Summary (FWS/OBS-76/28); Final Report (FWS/OBS-76/29), NTIS Accn. No. PB 263 470/AS (PC:A07/MF:A01); Rocky Mountain Case Studies (FWS/OBS-76/30, NTIS Accn. No. PB 263 471/AS (PC:A16/MF:A01); Pacific Northwest Case Studies (FWS/OBS-76/31), NTIS Accn. No. PB 263 472/AS (PC:A18/MF:A01). Contact Harvey Doerksen, Project Officer, U.S. Fish & Wildlife Service, WELUT, Fort Collins, CO 80521 for availability.

065

PROJECT TITLE: Upper Missouri Reservoir Investigations (WELUT No. 033-76)

INVESTIGATOR/ORGANIZATION: U.S. Fish and Wildlife Service Research, North Central Reservoir Investigations, Pierre, SD

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

FUNDING AMOUNT: \$50,000

DURATION: 5/76 - 5/77 (Completed)

LOCATION: MT - Fort Peck Reservoir; ND - Garrison Reservoir

DESCRIPTION: This project will identify the probable energy-impact areas in Fort Peck and Garrison Reservoirs, conduct limnological baseline studies and predict the effects of energy development in those areas. Based on information derived from this study, recommended strategies, criteria, and guidelines will be synthesized to provide practical development alternatives, mitigate losses and utilize development-related environmental modifications to enhance water quality and fish and wildlife habitat.

PUBLICATIONS: Final Report. U.S. Fish and Wildlife Service Research, North Central Reservoir Investigations, Pierre, SD. May 1977 (WELUT-77/07) Limited availability. Contact Project Officer, Lee Ischinger, U.S. Fish and Wildlife Service, WELUT, Fed. Bldg., Fort Collins, CO 80521.

066

PROJECT TITLE: The Water Quality and Aquatic Insects of the Musselshell River, Montana

INVESTIGATORS/ORGANIZATION: Mark Gorges, W.R. Gould, Cooperative Fishery Research Unit, Montana State Univ., Bozeman, MT 59715

FUNDING AGENCY: State of Montana (Mt. Dept. of Fish and Game)

FUNDING AMOUNT: \$7,000

DURATION: 6/74 - 2/76 (Completed)

LOCATION: MT - Wheatland, Golden Valley, Musselshell Counties (Six stations, from Two Dot and Melstone, covering 300 km on the Musselshell River were studied.)

DESCRIPTION: Purpose - To obtain baseline data on the water quality and aquatic insects of the Musselshell River before anticipated coal development in the Bull Mountains Coal Field takes place.

PUBLICATIONS: Mark Gorges. Master's Thesis. The Benthic Invertebrates of the Musselshell River, Montana.

067

PROJECT TITLE: Wildlife Inventory at Colstrip, Montana

INVESTIGATOR/ORGANIZATION: Robert E. Carroll, Ecological Consulting Service, 1300 Cedar Street, Helena, MT 59601, (406) 442-4650

067 CONT.

FUNDING AGENCY: The Montana Power Company, Butte, MT

DURATION: 1/72 - Continuing LOCATION: MT - Rosebud Co. (Colstrip)

DESCRIPTION: Wildlife monitoring of a 10 x 20 mile area centered on Colstrip to determine baseline wildlife population types, density, distribution, food habits, and range land uses.

PUBLICATIONS: Annual report for each year beginning in 1972 filed with the Mt. Dept. of Natural Resources, Mt. Dept. of State Lands, and the U.S. Geological Survey.

068

PROJECT TITLE: Wildlife Survey, Mining Areas A & B, Colstrip, Montana

INVESTIGATOR/ORGANIZATION: Robert E. Carroll, Ecological Consulting Service, 1300 Cedar Street, Helena, MT 59601, (406) 442-4650

FUNDING AGENCY: Western Energy Company DURATION: 12/72 - 12/73 (Completed)

LOCATION: MT - Rosebud Co. (Colstrip)

DESCRIPTION: Wildlife inventory of Western Energy Company's mining areas A and B to determine baseline wildlife, population types, density, food habits, and range land use.

PUBLICATIONS: Wildlife Investigations, Areas A and B, Colstrip, Montana, December 1972 to December 1973. Filed with the Department of State Lands and the Department of Natural Resources.

069

PROJECT TITLE: Wildlife Survey, Mining Areas D & E, Colstrip, Montana

INVESTIGATOR/ORGANIZATION: Robert Carroll, Ecological Consulting Service, 1300 Cedar St., Helena, MT 59601, (406) 442-4650

FUNDING AGENCY: Western Energy Company DURATION: 12/72 - 12/73 (Completed)

LOCATION: MT - Rosebud County (Colstrip)

DESCRIPTION: Wildlife inventory of Western Energy Company's mining areas D and E to determine baseline population types, density, food habits and range land use.

PUBLICATIONS: Wildlife Investigations, Areas D and E Colstrip, Montana, December 1972 to December 1973. Filed with the Mt. Dept. of State Lands and the Mt. Dept. of Natural Resources.

070

PROJECT TITLE: Yellowstone and Tongue River Fisheries Study

INVESTIGATORS/ORGANIZATION: Al Elser, Larry Peterman, Bob Newell, Mt. Dept. of Fish and Game, Box 430, Miles City, MT 59301, (406) 232-4365

FUNDING AGENCY: Old West Regional Commission (through the Mt. Dept. of Natural Resources)

FUNDING AMOUNT: \$83,000

DURATION: 8/74 - 12/76 (Completed)

LOCATION: MT - Tongue River (Big Horn, Rosebud, Custer Counties; Yellowstone River (Treasure, Rosebud, Custer, Dawson, and Richland Counties)

DESCRIPTION: Objectives - (1) To collect basic fish population data, species diversity, and longitudinal distribution on the Tongue River; (2) To identify and determine species diversity for aquatic invertebrates and forage fish on the middle and lower Yellowstone River; and (3) To assess potential effects of dewatering on these components of the ecosystem. (NOTE: This study is a sub-project of A Study to Evaluate Potential Physical, Biological, and Water Use Impacts of Water Withdrawals and Water Development on the Middle and Lower Portions of the Yellowstone River Drainage in the State of Montana, Project No. 402.)

PUBLICATIONS: Final report. July 1977.

071

PROJECT TITLE: Yellowstone River Fisheries Study

INVESTIGATORS/ORGANIZATION: Larry Peterman and Mike Haddix, Mt. Dept. of Fish and Game, P.O. Box 430, Miles City, MT 59301, (406) 232-4365

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Reclamation

FUNDING AMOUNT: \$50,000

DURATION: 4/74 - 6/76 (Completed)

LOCATION: MT - Yellowstone River, Big Horn River to mouth.

DESCRIPTION: The objectives of this project are to collect basic inventory and life history data to develop better understandings of existing fish populations and habitats needed to sustain the species present. This information will be used for making decisions and recommendations on diversion points, and for accurate preparation of environmental impact statements. To accomplish the objective, work is being directed toward (1) equipment development and sampling technique adaptation; (2) field life history studies of important fish species of the lower Yellowstone; and (3) predicting effects of proposed flow changes on important life history stages. Important fish species which are being studied include the channel catfish, sauger and walleye, burbot, shovelnose sturgeon and pallid sturgeon. Data was also collected on other species during general sampling surveys. Forage fish species were sampled but have not yet been identified. A food habits study was initiated which will, when completed, identify forage fish species important to the major sport fish populations.

PUBLICATIONS: M.H. Haddix and C. Estes. Lower Yellowstone River Fishery Study, Final Report. 1977. Mt. Dept. of Fish and Game, Helena, MT.

072

PROJECT TITLE: Yellowstone River Migratory Bird Study

INVESTIGATOR/ORGANIZATION: Tom Hinz, Mt. Dept. of Fish and Game, Box 430, Miles City, MT 59301, (406) 232-4365

FUNDING AGENCY: Old West Regional Commission (through the Mt. Dept. of Natural Resources and Conservation)

FUNDING AMOUNT: \$63,000

DURATION: 9/74 - 12/76 (Completed)

LOCATION: MT - Yellowstone River

DESCRIPTION: Objectives - (1) To inventory and assess importance of Yellowstone River to migratory birds; and (2) To assess effects of altered stream flows on migratory birds using the river. (NOTE: This study is a sub-project of A Study to Evaluate Potential Physical, Biological, and Water Use Impacts of Water Withdrawals and Water Development on the Middle and Lower Portions of the Yellowstone River Drainage in the State of Montana, Project No. 402.)

PUBLICATIONS: The results of this research will appear in a technical report which will be submitted to the Old West Regional Comm. at conclusion of project.

COAL/Biological

Vegetation Studies

073

PROJECT TITLE: Circle West Vegetation Inventory

INVESTIGATOR/ORGANIZATION: Joe Elliott, Olson-Elliott & Associates, P.O. Box 1209, 349 N. Main, Helena, MT 59601, (406) 443-5560

FUNDING AGENCY: State of Montana (Mt. Dept. of Natural Resources)

FUNDING AMOUNT: \$12,456

DURATION: 6/76 - 12/77

LOCATION: MT - McCone County and adjacent areas

DESCRIPTION: Field vegetation data was obtained over the Circle West Project study area. Data is being used to develop a classification system to map vegetation communities of the study area.

PUBLICATIONS: Preliminary field data submitted to the Energy Planning Division, Mt. Dept. of Natural Resources and Conservation, Helena, MT.

074

PROJECT TITLE: Coal Development: SO₂ Effects on Nitrogen Fixing Systems in Agricultural and Native Plant Species (ERDA No. 31-109-38-3717)

074 CONT.

INVESTIGATOR/ORGANIZATION: Richard P. Sheridan, Dept. of Botany, Univ. of Montana, Missoula, MT 59812, (406) 243-2631

FUNDING AGENCY: U.S. Energy Research and Development Administration, Argonne National Laboratory

FUNDING AMOUNT: \$6,400

DURATION: 10/76 - 3/77 (Completed)

LOCATION: MT, Northern Great Plains

DESCRIPTION: The purpose of the experiments will be to supply nitrogen fixation background information to ERDA headquarters. The information will be used to determine the impacts of surface mining on selected areas in the Northern Great Plains. Sulfur dioxide experiments will be conducted from October 1976 through March 1977.

PUBLICATIONS: Report to ERDA.

075

PROJECT TITLE: Color Infrared Baseline Study

INVESTIGATOR/ORGANIZATION: Robert E. Carroll, Ecological Consulting Service, 1300 Cedar, Helena, MT 59601, (406) 442-4650

FUNDING AGENCY: Mt. Energy and MHD Research and Development Institute, Butte, MT

DURATION: 8/76 - 9/76 (Completed)

LOCATION: MT - Silver Bow County

DESCRIPTION: Project involves developing a rectified photobase of a 16 square mile study area near Butte, Montana. Providing contours and interpreting false color infrared aerial film to characterize vegetation. The study area is the site of a proposed power plant.

PUBLICATIONS: Maps with legends were submitted to the Mt. Energy and MHD Research and Development Institute, Butte, MT.

076

PROJECT TITLE: Color Infrared Vegetative Study

INVESTIGATOR/ORGANIZATION: Robert E. Carroll, Ecological Consulting Service, 1300 Cedar, Helena, MT 59601, (406) 442-4560

FUNDING AGENCY: Econ Inc., Ecological Consulting Service

DURATION: 3/76 - Continuing

LOCATION - MT (various sites)

DESCRIPTION: A study to determine the smallest scales of vertical aerial false color infrared photography in which certain vegetative species may be discriminated at various seasons. Information from this in-house study will be used for future energy developments.

077

PROJECT TITLE: Computer Analysis of Landsat (ERTS-1) Scene of the Big Horn River Downstream of Hardin, Montana

INVESTIGATOR/ORGANIZATION: D. Lee Miller, Civil Engineering Department, Colorado State University, Fort Collins, CO 80523

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service

FUNDING AMOUNT: \$6,865 - USFWS; \$3,000 - in house

DURATION: 6/75 - 3/76 (Completed)

LOCATION: MT - Big Horn, Yellowstone, and Treasure Counties (Big Horn drainage in Yellowstone Basin)

DESCRIPTION: The Fish and Wildlife Service contracted with CSU to perform a computer analysis of part of a Landsat (ERTS-1) scene to determine whether various riparian plant communities can be readily identified and quantified. Scene number 8171517216000 of July 8, 1974 is being analyzed. Ground truth inputs consist of a covertime map prepared by the USFWS in 1974 and 1975 of 1:24,000 scale color infrared photography. As of October 1, 1975, the 6 quads had been rotated and geometrically corrected and training site selection completed. Output product will be at the scale of 1:24,000. The location of the study is of the following USGS 7 1/2 grade maps: Big Horn, Foster, Hardin, Marsh, Coulee, Mission Creek, and 9-mile point.

PUBLICATIONS: Michael J. Erwin and Jerald Stroebele. Billings Area Office Remote Sensing Activities. August 1976. U.S. Fish and Wildlife Service. A copy of the report is available from USFWS, Biological Services, P.O. Box 25486, DFC, Denver, CO 80225.

078

PROJECT TITLE: A Cooperative Evaluation of Potential Air Pollution Injury to Coniferous Habitats on National Forest Lands Near Colstrip, Montana

INVESTIGATORS/ORGANIZATIONS: Clancy C. Gordon, Dept. of Botany, Univ. of Montana, Missoula, MT 59801, (406) 243-2671; Clinton E. Carlson, Air Pollution Group, USDA Forest Service, Missoula, MT, (406) 549-6511

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service

FUNDING AMOUNT: Approx. \$90,000 (FY77 - \$36,000)

DURATION: 6/75 - 6/78

LOCATION: MT - Powder River and Rosebud Counties, Ashland Div., Custer Nat'l. Forest

DESCRIPTION: Project Objectives - (1) To establish 12 ponderosa pine study plots (three plots between Colstrip and the northwest boundary of the Custer Nat'l. Forest and nine plots within the Custer National Forest) which are potentially high air pollution impact areas of the atmospheric emissions of

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the coal-fired power plants being built at Colstrip Montana; (2) To establish 10 other ponderosa study plots on the Custer National Forest which are selected on the basis of the major ponderosa pine site classes which are representative of those on the Custer National Forest; (3) To evaluate physical and biological characteristics of the 12 study sites; and (4) To characterize baseline conditions in selected grassland areas within the Forest boundary.

PUBLICATIONS: Clancy C. Gordon, Clinton E. Carlson, and P.C. Tourangeau. A Cooperative Evaluation of Potential Air Pollution Injury and Damage to Coniferous Habitats on National Forest Lands Near Colstrip, MT. Report No. 76-12. 1976. Progress reports are available from: Air Pollution Group, Div. of Forest Environmental Protection, USDA Forest Service, No. Region, Missoula, MT.

079

PROJECT TITLE: Effects of Air Pollution on Epiphytic Cryptograms (NSF No. GB-42179)

INVESTIGATOR/ORGANIZATION: G.R. Hoffman, Univ. of So. Dakota, Dept. of Biology, Vermillion, SD 57069

FUNDING AGENCY: U.S. National Science Foundation, Division of Biological and Medical Sciences

FUNDING AMOUNT: \$14,750

DURATION: 3/75 - 2/76

LOCATION: SD, MT, WY, MN

DESCRIPTION: This project will utilize the known sensitivity of epiphytic lichens and bryophytes to air pollutants to evaluate the extent of the air pollution (chiefly sulfur dioxide) created by the lignite-burning power generator that will begin operation in 1975. Unlike any previous evaluations of air pollution using epiphytic lichens as indicators, this project will determine the prior distribution of the epiphytic vegetation in essentially air pollution-free northern prairie areas. This will be established in a broad transect across So. Dakota from middle Minnesota to the eastern Wyoming and Montana. Efforts will be concentrated, however, in the broad area around the Otter Tail Power Generator and will include both stem and canopy epiphytes. Any changes in the epiphytic flora after the pollution begins can, therefore, be compared with the baseline vegetation with little air pollution.

080

PROJECT TITLE: Geochemical Survey of Vegetation in the Western Energy Regions

INVESTIGATORS/ORGANIZATION: James A. Erdman and Barbara M. Anderson, U.S. Geological Survey, Box 25046, Federal Center, MS 925, Denver, CO 80225, (303) 234-5240

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey

DURATION: 7/74 - 1979

LOCATION: Rocky Mountain and No. Great Plains Region

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DESCRIPTION: The principal objective of the project is to make a reconnaissance geochemical survey of the area of energy resources in the Rocky Mountain region and the No. Great Plains. The survey will emphasize the geochemistry of the vegetation -- both native (principally big sagebrush) and field crops (hard red wheat) -- and to a limited degree the associated soils which occur in this area. Initial studies of the program have attempted to quantify geochemical differences among or within the major energy regions of the West, and will provide baseline data which can be used to monitor possible future changes in the geochemical environment due to energy, in particular coal development. Adjunct studies of coal-spoil reclamation and rehabilitation areas are being conducted to assess possible alterations in the local trace element environments. (NOTE: This is a sub-project of A Geochemical Survey of the Western Coal Regions, Project No. 194.)

PUBLICATIONS: James A. Erdman and Larry P. Gough. Variation in the Element Content of *Parmelia Chlorochroa* from the Powder River Basin of Wyoming and Montana. In The Bryologist, Vol. 80, No. 2, Summer 1977. (2) J.A. Erdman, L.P. Gough, and R.W. White. Calcium Oxalate as Source of High Ash Yields in the Terricolous Lichen *Parmelia chlorochroa*. In The Bryologist, Vol. 80, No. 2, Summer 1977.

081

PROJECT TITLE: The Impact of the Fuel Conversion Process on Native Vegetation in the Vicinity of Colstrip, Montana

INVESTIGATORS/ORGANIZATION: Frank F. Munshower, Ed Depuit, Dennis Neuman, Animal and Range Science Department, Montana State Univ., Bozeman, MT 59715 (406) 994-4821

FUNDING AGENCY: U.S. Energy Research and Development Administration, Ames Laboratory, Iowa State University

FUNDING AMOUNT: \$41,000 FY77

DURATION: 6/75 - 9/78

LOCATION: MT - Rosebud County (vicinity of Colstrip)

DESCRIPTION: This study will provide a model of heavy metals and pollutants in coal and their fate after combustion in the power plant. Release in stack gases and deposit by wet or dry deposition on or in vegetation in terrestrial or aquatic ecosystems will be measured.

PUBLICATIONS: Progress reports. Research Reports No. 71 and 98, MAES, Montana State Univ., Bozeman, MT 59715.

082

PROJECT TITLE: Infrared Vegetation Study

INVESTIGATOR/ORGANIZATION: Robert E. Carroll, Ecological Consulting Service, 1300 Cedar, Helena, MT 59601, (406) 442-4650

FUNDING AGENCY: The Montana Power Company, Butte, MT

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DURATION: 7/73 - Continuing

LOCATION: MT - Rosebud County (Colstrip)

DESCRIPTION: Aerial infrared filming and interpretation to obtain baseline vegetation types and conditions in the 10 x 20 mile area centering on Colstrip. This will be conducted annually for a number of years in the future to monitor the area for any changes and signs of stress.

PUBLICATIONS: 10 x 20 Mile Area Infrared Report, Colstrip, Montana, to the Montana Power Company Utilizing June 22, 1973 Aerial Color Infrared. Filed with the Mt. Dept. of Natural Resources and Conservation and the Mt. Dept. of State Lands, Helena, MT.

083

PROJECT TITLE: Monitoring Plant Community Changes Due to Fossil Fuel Power Plants

INVESTIGATOR/ORGANIZATION: John E. Taylor, Dept. of Animal and Range Sciences, Montana State University, Bozeman, MT 59715, (406) 994-3721

FUNDING AGENCY: U.S. Environmental Protection Agency, Corvallis Environmental Research Laboratory, Corvallis, OR

FUNDING AMOUNT: \$265,000

DURATION: 7/74 - 7/80

LOCATION: MT - Rosebud County (Colstrip)

DESCRIPTION: The scope of this project may be seen in the objectives, which are: (1) To record native plant communities in areas likely to be affected by fossil fuel power plants and in areas actually being affected; (2) To monitor plant species and community responses to artificially applied air pollution stress; (3) To refine field procedures for aerial photo interpretation, diversity, phenology, and cover data; (4) To collect data to be used in simulation modeling; and (5) To develop detailed vegetation maps of study areas. This work is closely related to biomass and community dynamics studies being conducted by scientists from Colorado State University. It also supports projects in vertebrate animal populations, plant physiology, lichen ecology, plant pathology, and insect ecology (all under the general EPA project). (NOTE: This study is a part of The Bioenvironmental Impact of a Coal-Fired Power Plant, Project No. 117.)

PUBLICATIONS: See The Bioenvironmental Impact of a Coal-Fired Power Plant, First Interim Report, December 1974; Second Interim Report, June, 1975. Corvallis Environmental Research Laboratory, U.S. Environmental Protection Agency. Contact investigator for list of additional publications related to this project.

084

PROJECT TITLE: Nance Mine Vegetation Baseline Data Inventory

INVESTIGATORS/ORGANIZATION: Dana Schmidt, Peter Husby, Joe Antose, Joe Elliott, Gerald Moore, Olson-Elliott & Associates, P.O. Box 1209, Helena, MT 59601, (406) 443-5560

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FUNDING AGENCY: MONTCO (through the Mt. Dept. of State Lands, Helena, MT)

FUNDING AMOUNT: \$26,774

DURATION: 7/77 - 9/78

LOCATION: MT - Rosebud County (Tongue River Drainage, Birney Area)

DESCRIPTION: The study is designed to provide baseline vegetation data as to plant community composition, production, and plant species of the area. The data is to be used for pre-mining evaluation of the site.

085

PROJECT TITLE: Off-Road Vehicle Impact on Grasslands of the Ashland Division, Custer National Forest

INVESTIGATOR/ORGANIZATION: Gene F. Payne, Animal and Range Sciences Dept., Montana State University, Bozeman, MT 59715, (406) 994-3721

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service

FUNDING AMOUNT: \$4,200

DURATION: 1976 - 10/77

LOCATION: MT - Ashland Division, Custer National Forest

DESCRIPTION: As southeastern Montana energy development progresses, there will be increased pressures on federal and state lands for recreational use. This project investigates the impact of off-road vehicles on a grassland on the Ashland Division, Custer National Forest. The impacts were applied at monthly intervals May through September, 1976. Soil and vegetation responses were evaluated in 1976 and will continue in 1977.

086

PROJECT TITLE: Peabody Annual Vegetation Study

INVESTIGATOR/ORGANIZATION: Robert E. Carroll, Ecological Consulting Service, 1300 Cedar, Helena, MT 59601, (406) 442-4650

FUNDING AGENCY: Peabody Coal Company

DURATION: 1/77 - 11/77

LOCATION: MT - Rosebud Co. (Colstrip area)

DESCRIPTION: A study to obtain annual vegetation production on the Peabody mining areas at Big Sky Mine at Colstrip.

PUBLICATION: Annual report filed with the Mt. Dept. of State Lands and the U.S. Geological Survey.

087

PROJECT TITLE: Photographic Monitoring of Native Vegetation for Air Quality Studies

INVESTIGATOR/ORGANIZATION: John E. Taylor, Animal and Range Sciences Dept., Montana State Univ., Bozeman, MT 59715, (406) 994-3721

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Indian Affairs

FUNDING AMOUNT: \$62,102

DURATION: 10/76 - 9/78

LOCATION: MT - Crow and Cheyenne Reservations and adjacent areas

DESCRIPTION: The objectives of this study are (1) To gather baseline data on selected examples of native grassland, shrubland, and forest vegetation types; (2) To develop procedures for long-term monitoring of changes in these types; (3) Specifically to study native vegetation types for any changes induced by air pollution or other disturbances caused in connection with the development of mining or energy production on the reservations or on adjacent land.

088

PROJECT TITLE: Physiological Responses of Vegetation to Coal-Fired Power Plant Emissions

INVESTIGATOR/ORGANIZATION: Richard Field, Corvallis Environmental Research Laboratory, U.S. Environmental Protection Agency, 200 SW 35th Street, Corvallis, OR 97330, (503) 752-4211

FUNDING AGENCY: U.S. Environmental Protection Agency, Corvallis Environmental Research Laboratory

DURATION: 6/74 - 6/79

LOCATION: MT - Rosebud County (Colstrip)

DESCRIPTION: This component of the Coal-fired Power Plant Project is designed to supply plant physiological support. This will be accomplished by: (1) experimentally assessing the sensitivity of selected plant species to ozone, nitrogen dioxide alone, sulfur dioxide alone, and to mixtures of these three gases; (2) Determining the influence of moisture stress on sensitivity and growth of native plants exposed to sulfur dioxide, nitrogen dioxide and to mixtures of these; and (3) Measuring rates of uptake of SO₂ and NO₂ by the plants. (NOTE: This study is a sub-project of The Bioenvironmental Impact of a Coal-Fired Power Plant, Project No. 117.)

PUBLICATIONS: See The Bioenvironmental Impact of a Coal-Fired Power Plant, First Interim Report, December 1974; Second Interim Report, June 1975 (EPA-600/3-76-013).

089

PROJECT TITLE: Plant Information Network (PIN), (WELUT No. 005-76)

INVESTIGATORS/ORGANIZATION: Robert P. Adams, Phillip L. Sims, Dieter H. Wilken, Dept. of Botany and Plant Pathology & Dept. of Range Science, Colorado State

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University, Fort Collins, CO 80523

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

FUNDING AMOUNT: \$142,656

DURATION: 6/76 - 11/77 (An evaluation phase has been initiated and will be continued providing sufficient funding is available.)

LOCATION: MT, WY, CO

DESCRIPTION: An information system for cataloging taxonomic, geographical, ecological, biological and economic information on plant species will be modified and tested on the Colorado and Montana-Wyoming Test Areas. The result will be an operational system to aid in the selection of vegetative species that can grow under specified site and land-use conditions and serve as a geographic locator system to identify similar habitats.

PUBLICATIONS: (1) Magnetic tapes of the Rapid Access Plant Information Retrieval (RAPIR) software modified for PIN; (2) Magnetic tapes of the Plant Information Network (PIN) data bank; (3) P.L. Sims and K.C. Vories, The Plant Information Network: Volume I, A Users Guide (FWS/OBS-77/38); Volume II, Reclamation and PIN in Northwestern Colorado (FWS/OBS-77/39) Volume III, Reclamation and PIN in the Powder River Basin of Montana and Wyoming (FWS/OBS-77/40); Volume IV, A Subject Guide and Annotated Bibliography of Selected Literature on Land Reclamation and Rehabilitation in the United States (FWS/OBS-77/41), September 1977.

090

PROJECT TITLE: Poplar River Vegetation Effects Study

INVESTIGATOR/ORGANIZATION: Norman Glass, Corvallis Environmental Research Laboratory, U.S. Environmental Protection Agency, 200 SW 35th Street, Corvallis, OR 97330, (503) 752-4211

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$15,000

DURATION: 1/77 - 12/77

LOCATION: MT - Poplar River

DESCRIPTION: Because of the existing wheat industry in Northeastern Montana, as well as the concern for the protection of other vegetation from the harmful effects of air pollutants, a detailed study will be performed to document the threshold air quality levels which are injurious to crops and vegetation. Wheat and other cereal crops in the germination stage will be studied. Vegetation sensitivity will be analyzed. An initial step will be to evaluate the existing land use. A second step will be to perform a literature search on the effects of air pollutants on the pertinent species. The final phase of this program will be to conduct greenhouse studies in order to collect those missing data.

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PUBLICATIONS: Progress reports are available from the Montana Energy Office, Helena, MT 59601.

091

PROJECT TITLE: A Study of the Range Resource in the Vicinity of Colstrip, MT

INVESTIGATORS/ORGANIZATION: Frank F. Munshower, Richard L. Hodder, Ed Depuit, Dept. of Animal and Range Sciences, Montana State Univ., Bozeman, MT 59715, (406) 994-4821

FUNDING AGENCY: The Montana Power Company, Butte, Montana

FUNDING AMOUNT: \$200,000 to date (FY77 \$60,000) DURATION: 6/72 - Continuing

LOCATION: MT - Rosebud County (Colstrip)

DESCRIPTION: The ultimate objective of this study is to determine whether stack emissions from the coal-fired steam electric generating complex at Colstrip, Montana damage vegetation and thus affect the economy of the local livestock industry or crop producers. This is to be determined by a study of S, F, Zn, Cu, Mu, Pb, Cd, and N concentrations in grasses, forbs, shrubs and trees near Colstrip, Montana.

PUBLICATIONS: Annual report for each year beginning in 1972. Available from the Montana Agricultural Experiment Station Library, Bozeman, MT.; Research Report #71, January 1975, The Effect of Stack Emissions on the Range Resource in the Vicinity of Colstrip, Montana; F.F. Munshower, B.W. Sindelar, and D.R. Neuman, Elemental Concentrations in Range Vegetation and Animals, 1972-1974, Montana Agricultural Experiment Station, Montana State Univ., Bozeman, Montana.

092

PROJECT TITLE: Use of Lichens as Indicators and Predictors of Air Pollution from a Coal-Fired Power Plant (EPA R-803213)

INVESTIGATOR/ORGANIZATION: Sharon Eversman, Biology Department, Montana State Univ., Bozeman, MT 59715, (406) 994-3231

FUNDING AGENCY: U.S. Environmental Protection Agency, Corvallis Environmental Research Laboratory, Corvallis, OR

FUNDING AMOUNT: \$23,448 to date (FY77 \$14,222) DURATION: 7/74 - 7/80

LOCATION: MT - Rosebud and Powder River Counties

DESCRIPTION: Two lichen species native to southeast Montana showed reduced respiration rates and algal cell plasmolysis and bleaching when exposed to .02, .04, and .07 ppm SO₂ (geometric means) on a field fumigation site. The major objective of the current project is to collect these same two lichen species to be observed as biological monitors of SO₂ emissions from two coal-fired power plants in Colstrip, Montana. Lichen community information is also being

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collected in order to detect any changes in epiphytic and soil lichen communities as coal burning proceeds in this area. All the lichen information will be integrated with plant community data gathered by other researchers in this region in order to determine the effects of SO₂ emissions (and other pollutants from coal-burning) on Ponderosa pine-grassland ecosystems.

PUBLICATIONS: See The Bioenvironmental Impact of a Coal-Fired Power Plant, First Interim Report, December 1974; Second Interim Report, June 1975, Corvallis Environmental Research Laboratory, U.S. EPA, Corvallis, OR 97330.

093

PROJECT TITLE: Vegetation Production Study -- Colstrip

INVESTIGATOR/ORGANIZATION: Robert E. Carroll, Ecological Consulting Service, 1300 Cedar, Helena, MT 59601, (406) 442-4650

FUNDING AGENCY: Western Energy Company, Butte, Montana

DURATION: 1/76 - Continuing LOCATION: MT - Rosebud Co. (Colstrip)

DESCRIPTION: Study to obtain annual vegetation production of a several square mile area at Colstrip, Montana.

PUBLICATIONS: Annual reports are filed with the Mt. Dept. of State Lands.

COAL/Biological

Wildlife & Veg. Studies

094

PROJECT TITLE: Assessment and Implementation of In-Stream Value Studies for the Northern Great Plains

INVESTIGATORS/ORGANIZATION: Arnold J. Silverman, Ken Bovee, James A. Gore, University of Montana, Missoula, MT 59801, (406) 243-5151

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$74,394 DURATION: 1/74 - 3/77 (Completed)

LOCATION: MT (Tongue River), Northern Great Plains Region

DESCRIPTION: The contract involves the field testing, modification and verification of a methodology that can be used to assess and predict changes in plant and animal ecosystems due to stream flow changes. This verified methodology shall allow the prediction of changes in the aquatic ecosystem and other sensitive plant and animal communities with variations in stream flow. Presently, effects of regulating a stream flow for a warm-water fishery are not known although some information is available for cold-water, salmonid fisheries.

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The contract shall be conducted in two phases. The first phase shall involve the collection of biological data for the river system under study. This data shall be used both in the determination of a base-line system and in the establishment of additional flow requirement criteria. The second phase shall involve the application of the methodology for various discharges.

PUBLICATIONS: Ken Bovee. The Determination, Assessment, and Design of In-Stream Value Studies for the Northern Great Plains Region. September 1974. University of Montana, Missoula, MT; Field Testing and Adaptation of a Methodology to Measure In-Stream Values in the Tongue River, Northern Great Plains Region, Final Report (anticipated publication, Fall 1977).

095

PROJECT TITLE: Atmospheric Sciences: Potential of Energy Extraction and Conversion Processes in the Northern Great Plains for Sulfur, Fluorine, Heavy Metals Contamination in Terrestrial and Aquatic Ecosystems and Its Impact on Plant Community Productivity and Stability Including Secondary Effects on Animal Species in the Food Chain

INVESTIGATORS/ORGANIZATIONS: James O'Toole, Ames Laboratory, U.S. Energy Research and Development Admin., Ames, IA 50010, (515) 294-2500; Clarence C. Gordon, Department of Botany, Univ. of Montana, Missoula, MT 59801, (406) 243-2671

FUNDING AGENCY: U.S. Energy Research and Development Administration

FUNDING AMOUNT: \$460,000 to date (FY77 \$390,000) DURATION: 6/75 - 9/80

LOCATION: MT - Rosebud and Powder River Counties

DESCRIPTION: This research project includes the following division of effort: (1) A mass balance study of the Colstrip generating station which will include a qualitative description and quantitative measurement of the flow through of major and minor elements with an evaluation of their release rate and dispersion; (2) A sampling program designed to evaluate the wet and dry deposition rates of air pollutants emanating from the Colstrip stacks as they are related to distance, direction and terrain features; (3) An assessment of the uptake by terrestrial plant species of pollutants resulting from fuel conversion including measurement of deposition rate, retention and bio-concentration; (4) Through a judicious sampling and analytical program, the appearance of pollutant elements in the principal animal species at these sites will be observed; (5) The efficiency and rate at which fallout of elemental pollutants originating from Colstrip stacks are transported down a model watershed and to its impoundment will be measured; (6) Laboratory studies designed to rate the uptake of key pollutant elements by algae and plant species resident to the impoundment site will be carried out; (7) In laboratory studies with ruminant animals, using appropriate radioactive tracers, the rate of uptake, turnover and elimination of key pollutant elements which deposit on vegetation will be measured; (8) The data obtained in these investigations will be applied to the preparation of a dynamic model whose purpose will be to describe the accumulation of pollutants, their effect on vegetation productivity and the bioconcentration transfer rates of pollutant elements to herbivores and omnivores in the food chain. (NOTE: This study also includes research programs at Montana State Univ. and Battelle Northwest Laboratories.)

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PUBLICATIONS: (1) C.C. Gordon, P.C. Tourangeau. Potential of Energy Extraction Processes in the Northern Great Plains for Heavy Metal Contamination and Consequent Uptake and Turnover in a Range Ecosystem Model, First Annual Report, 1976. Activity RX-02-03, Ames Laboratory, Iowa State Univ., Ames, IA; (2) F. Munshower and E.J. Depuit. The Effects of Stack Emissions on the Range Resource in the Vicinity of Colstrip, Montana, Research Report 98, Mt. Agric. Exp. Station, Montana State Univ., Bozeman, MT, November 1976; (3) P.C. Tourangeau, C.C. Gordon, and C.E. Carlson. Fluoride Emissions of Coal Fired Power Plants and Their Effects Upon Plant and Animal Species. In Fluoride, Vol. 10, No. 1, April 1977.

096

PROJECT TITLE: Baseline Data Monitoring for Selected Elements and Compounds in Flora and Fauna of Eastern Montana Coal Area

INVESTIGATOR/ORGANIZATION: Clancy C. Gordon, Dept. of Botany, Univ. of Montana, Missoula, MT 59801, (406) 243-2671

FUNDING AGENCY: State of Montana (Mt. Dept. of Natural Resources and Conservation)

FUNDING AMOUNT: \$31,000

DURATION: 8/73 - 11/74 (Completed)

LOCATION: MT - Rosebud County (near Colstrip)

DESCRIPTION: The purposes of this study are to generate a baseline data bank of fluoride in plants and animals and sulfur in plants, and to determine precipitation chemistry at 35 locations in the vicinity of a proposed coal-fired steam electric generating complex near Colstrip, Montana. Chemical analyses were completed on over 3500 plant and 500 animal specimens. Over 500 microscope slides of Ponderosa pine needles were prepared. The results allowed the characterization of the fluoride and sulfur content of vegetation by season, species, and age of foliage. Comparisons between different groups of plants were made, and fluoride content of animals as a function of species and age was determined. Both fluoride and sulfur decreased over the dormant period in pines. Fluoride increased with the age of needles but sulfur did not. Sulfate concentrations ranged from C-20 MG/L in precipitation, and damage to pine needles bases caused by acid rains was observed.

PUBLICATIONS: See Draft Environmental Impact Statement on Colstrip Electric Generating Units 3 and 4, 5000 Kilovolt Transmission Lines and Associated Facilities, November 1974. Vol. 1-4.

097

PROJECT TITLE: Bibliography of Published Information on WELUT Test Areas (WELUT No. 030.1-76)

INVESTIGATOR/ORGANIZATION: Ecology Consultants, Inc., Fort Collins, CO

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

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FUNDING AMOUNT: \$53,881

DURATION: 9/76 - 6/77 (Completed)

LOCATION: Five WELUT test areas, MT, WY, CO, UT, NM, ID

DESCRIPTION: This study will locate and compile existing published technical information pertaining to the flora, fauna, and physical characteristics of the Regional Environmental Test Areas of the Western Energy and Land Use Team. Annotated and indexed bibliographies of published and unpublished (See Project No. 098) information will be prepared for each of the five RETAs.

PUBLICATIONS: Annotated Bibliography of Natural Resources Information: Powder River Basin, Northeastern Wyoming/Southeastern Montana (FWS/OBS-77/31); Southwestern North Dakota (FWS/OBS-77/32); Northwestern New Mexico (FWS/OBS-77/33); Southern Utah (FWS/OBS-77/34); Northwestern Colorado (FWS/OBS-77/35). All prepared by Ecology Consultants, Fort Collins, CO. September 1977. For availability contact the Project Officer, Bob Raleigh, Fish & Wildlife Service, WELUT, Federal Building, Fort Collins, CO 80521.

098

PROJECT TITLE: Bibliography of Unpublished Information on WELUT Test Areas (WELUT No. 030.2-76)

INVESTIGATORS/ORGANIZATIONS: Commissioner, North Dakota Fish and Game Dept., Bismarck, ND; Director, New Mexico Dept. of Game & Fish, Santa Fe, NM; Director, Division of Wildlife Resources, Salt Lake City, UT; Ecology Consultants, Inc., Fort Collins, CO

FUNDING AGENCY: U.S. Dept. of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

FUNDING AMOUNT: \$29,977

DURATION: ND 6/76 - 2/78; NM 7/76 - 6/77; UT 7/76 - 2/78; MT, WY, CO 9/76 - 5/77

LOCATION: Five WELUT test areas, MT, WY, CO, UT, NM, ID

DESCRIPTION: This study will locate and compile existing unpublished technical information pertaining to the flora, fauna, and physical characteristics of each of the five Regional Environment Test Areas of the Western Energy and Land Use Team.

PUBLICATIONS: Bibliography worksheets of unpublished information compiled for each test area will be utilized for Project No. 097.

099

PROJECT TITLE: Effects of SO₂ and Other Coal-Firing Plant Emissions on Producer, Invertebrate Consumer, and Decomposer Structure and Function in an Eastern Montana Grassland

INVESTIGATORS/ORGANIZATION: J.L. Dodd and William K. Lauenroth, Natural Resource Ecology Laboratory, Colorado State Univ., Fort Collins, CO 80523, (303) 491-5571

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FUNDING AGENCY: U.S. Environmental Protection Agency, Corvallis Environmental Research Center

FUNDING: 1974 \$75,000; 1975 \$125,000; 1976 \$155,000; 1977 \$150,000

DURATION: 6/74 - 6/79

LOCATION: MT - (Near Colstrip)

DESCRIPTION: The overall objective of this task is to determine the effects of coal-fired power plant emissions on the structure and function of a south-eastern Montana grassland ecosystem and to represent these effects in a total system simulation model. One set of objectives relates to monitoring of four grassland study sites (Hay Coulee, Kluver West, Kluver North, and Kluver East) near the coal-fired power plant at Colstrip, Montana. These sites are expected to be exposed to differing intensities of atmospheric pollution following completion of the plant during 1975. A second array of objectives relates to the field experimental study to be located ten miles of the Ft. Howes Ranger Station in the Custer National Forest. Our objectives are to determine the effects of three levels of SO_2 (2,5,10 pphm monthly median), a major component of power plant emissions on the seasonal biomass dynamics of the primary producers and on decomposition rates. A final set of objectives pertain to the adaptation of the Natural Resource Ecology Laboratory ecosystem level simulation model to the grassland type mentioned in the previous objectives.

PUBLICATIONS: See The Bioenvironmental Impact of a Coal-Fired Power Plant, First Interim Report, December 1974; Second Interim Report, June 1975 (EPA-600/3-76-013). Also W.K. Lauenroth, J.L. Dodd, R.K. Heitschmidt, and R.G. Woodmansee. Biomass Dynamics and Primary Production in Mixed Prairie Grasslands in Southeastern Montana: Baseline Data for Air Pollution Studies. April 1975. Fort Union Coal Field Symposium, Montana Academy of Sciences.

100

PROJECT TITLE: The Field Experimental Component: Evaluation of the Zonal Air Pollution System

INVESTIGATORS/ORGANIZATION: Jeffrey Lee and Denis E. Body, Corvallis Environmental Research Laboratory, U.S. Environmental Protection Agency, 200 SW 35th Street, Corvallis, OR 97330, (503) 752-4211

FUNDING AGENCY: U.S. Environmental Protection Agency

DURATION: 6/75 - 6/79

LOCATION: MT - (Near Colstrip)

DESCRIPTION: These experiments are designed to test the effects of SO_2 upon plant and animal biomass dynamics; plant community structure; insect and fungal diseases of plants; pollination systems; lichens; and upon a number of physiological and biochemical functions. This zonal air pollution system will consist of a separate SO_2 delivery system for each of the four one acre plots at the stress site, a common monitoring system, and a common electric power system. The system was designed to allow us to maintain a different constant 30-day median concentration on each plot during the growing season. The ultimate design goal was to provide a system for well-defined assessment of the sulfur dioxide impact on otherwise undisturbed grassland ecosystems. (NOTE:

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This study is a sub-project of The Bioenvironmental Impact of a Coal-Fired Power Plant, Project No. 117.)

PUBLICATIONS: See The Bioenvironmental Impact of a Coal-Fired Power Plant, First Interim Report, December 1974; Second Interim Report, June 1975 (EPA-600/3-76-013).

101

PROJECT TITLE: Habitat and Wildlife Evaluation on Potential Offstream Regulating Reservoir Sites Near Intake, Montana

INVESTIGATOR/ORGANIZATION: Jon Swenson, Mt. Dept. of Fish and Game, Box 86, Shephard, MT 59079

FUNDING AGENCY: Intake Water Company, Houston, Texas

FUNDING AMOUNT: \$33,450 (FY77 \$18,450) DURATION: 12/76 - 2/78

LOCATION: MT - Dawson Co. (near Intake south of the Yellowstone River)

DESCRIPTION: An area of land near Intake, Montana, lying south of the Yellowstone River encompasses several possible alternate sites for an off-stream regulating reservoir. Prior to the decision to construct such a reservoir, a comprehensive vegetation and wildlife survey is necessary to ensure that the effects of the reservoir will be minimal. Observations of migratory bird use along the Yellowstone River should be included. Objectives: (1) To prepare a vegetative cover map of the area; (2) To determine seasonal distribution, habitat use, and densities (where possible) of wildlife species inhabiting the area; (3) To conduct studies of migratory birds using the portion of the Yellowstone River which borders the area; and (4) To record the occurrence of species of special interest, such as eagle nests, prairie dog towns, and heron rookeries. Procedures will include the preparation of a map of vegetation types and surface hydrology of the area; use of color aerial photographs of the area; periodic aerial surveys and observations from systematic vehicle routes of major game species and migratory bird species.

102

PROJECT TITLE: Insect Study Project on the Northern Cheyenne Reservation

INVESTIGATORS/ORGANIZATION: Joe Elliott, Tom Olson, Olson-Elliott & Assoc., P.O. Box 1209, 349 N. Main, Helena, MT 59601, (406) 443-5560

FUNDING AGENCY: U.S. Dept. of the Interior, Bureau of Indian Affairs

FUNDING AMOUNT: \$27,410 DURATION: 7/76 - 5/78

LOCATION: MT - Northern Cheyenne Indian Reservation

DESCRIPTION: This study is a baseline inventory of insect and other damage to Ponderosa Pine on the Northern Cheyenne Indian Reservation. Baseline levels of fluoride and sulfur are also included. The information gathered in this study

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will be useful in determining the ultimate effects of the Colstrip power plants on the forest resource of the reservation.

PUBLICATIONS: Joe Elliott and Thomas Olson. Northern Cheyenne Forest Insect Study, Interim Report, 1977. Unpublished data summary of initial sampling season. Report submitted to the BIA, Div. of Forestry, Lame Deer, Montana.

103

PROJECT TITLE: Investigation of the Bioenvironmental Impact of Fossil Fuel Power Plants in the Fort Union Basin of Montana (EPA R803215-02-0)

INVESTIGATOR/ORGANIZATION: Clancy C. Gordon, Dept. of Botany, Univ. of Montana, Missoula, MT 59801, (406) 243-2671

FUNDING AGENCY: U.S. Environmental Protection Agency, Corvallis Environmental Research Laboratory

FUNDING: 1975 \$58,066; 1976 \$80,000; 1977 \$80,000

DURATION: 8/74 - 6/79

LOCATION: MT - (near Colstrip)

DESCRIPTION: The major objective of this project component is to conduct extensive studies on species of flora and fauna surrounding Colstrip, Montana, prior to and after two 350-megawatt coal-fired power plants become operational. The work is to be conducted in such a way that predictive models can be generated and the results of our investigations can be integrated with those of the component investigations so that a predictive impacts assessment protocol can be generated. The University of Montana Environmental Studies Laboratory portion of this project is designed to establish the baseline levels of (1) fungal populations (both beneficial and pathogenic), (2) insect populations (both beneficial and destructive), (3) the sulfur and fluoride concentrations within selected species of indigenous vegetation of the Colstrip area, (4) the chemistry of the area's precipitation, and (5) the growth of the predominant coniferous species, ponderosa pine. (NOTE: This study is a sub-project of The Bio-environmental Impact of a Coal-Fired Power Plant, Project No. 117.)

PUBLICATIONS: See The Bioenvironmental Impact of a Coal-Fired Power Plant, First Interim Report, December 1974; Second Interim Report, June 1975 (EPA-600-3-76-013).

104

PROJECT TITLE: LANDSAT Digital Data Classification (WELUT No. 004-2-76)

INVESTIGATOR/ORGANIZATION: Robert H. Rogers, Bendix Aerospace Systems Division, 3621 South State, Ann Arbor, MI

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

FUNDING AMOUNT: \$129,500

DURATION: 9/76 - 12/77

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LOCATION: Five WELUT Regional Environmental Test Areas in SD, WY, CO, UT, NM (Powder River County and part of the Crow Indian Reservation in Montana)

DESCRIPTION: This study will obtain and process LANDSAT digital data by computer to produce vegetation and land-use surface feature classifications according to a classification system to be supplied by FWS on the five Regional Environmental Test Sites. Error analysis and quantitative evaluation will be conducted on classification accuracy, geographic accuracy, and areal measurement precision on all areas classified.

PUBLICATIONS: Products will include (1) A manual explaining the methods, applicability, advantages, and disadvantages, and limitations of LANDSAT digital data relative to fish and wildlife habitat evaluations; (2) Computer written, color-coded maps for all the land area within each Regional Environmental Test Area at a scale of 1:250,000; (3) Error Analysis, specific to surface feature classes examined, yielding error estimate from which the utility of LANDSAT data for particular wildlife-related application can be assessed.

105

PROJECT TITLE: Potential of Energy Extraction Processes in No. Great Plains for Heavy Metals Contamination and Consequent Uptake and Turnover in a Range Ecosystem Model

INVESTIGATOR/ORGANIZATION: Clancy C. Gordon, Dept. of Botany, Univ. of Montana, Missoula, MT 59801, (406) 243-2671 (Other investigators include James O'Toole, Ames Laboratory, Iowa State University, Frank Munshower, Montana State Univ., and Battelle Northwest Institute.)

FUNDING AGENCY: U.S. Energy Research and Development Administration, Ames Laboratory

FUNDING AMOUNT: \$130,460 to date (FY77 \$90,000) DURATION: 6/75 - 9/80

LOCATION: MT - Colstrip area

DESCRIPTION: Objectives - (1) To determine the baseline levels of trace elements, sulfur, and fluoride in the flora and fauna of the Colstrip area of Montana during the pre- and post-operation of Colstrip Unit #1; (2) To determine the baseline levels of various physical parameters (ph, NO_3 , NH_4 , selected trace metals, fluoride, sulfur, and total acidity) of the rainwater in the Colstrip area during the pre- and post-operational periods at Colstrip Unit #1; (3) To determine the fallout of trace elements, sulfur, fluoride at four air monitoring sites within ten miles of Colstrip during the next four years. (NOTE: This study is a sub-project of Project No. 095.)

PUBLICATIONS: C. C. Gordon and P. C. Tourangeau. 1976. First Annual Progress Report to ERDA, Potential of Energy Extraction Processes in the Northern Great Plains for Heavy Metal Contamination and Consequent Uptake and Turnover in a Range Ecosystem Model. (Ames Laboratory, Iowa State University, Ames, IA.)

106

PROJECT TITLE: Powder River Ecology Study

INVESTIGATOR/ORGANIZATION: Bruce Rehwinkel, Mt. Dept. of Fish and Game, Box 430, Miles City, MT 59301

FUNDING AGENCY: Utah International, Inc.

FUNDING AMOUNT: \$88,000

DURATION: 9/75 - 6/78

LOCATION: MT - Powder River, Custer, Prairie Counties (Powder River)

DESCRIPTION: Objectives - (1) To determine composition, distribution, and relative abundance of aquatic biota of the Powder River; (2) To identify various physical and chemical characteristics of the Powder River and its major tributaries; and (3) To predict and evaluate the impact of an impoundment on the existing Powder River biota, and to predict the composition, distribution, and relative abundance of aquatic biota which might exist as a result of an impoundment.

PUBLICATIONS: Annual reports are available from the Mt. Dept. of Fish and Game, Helena, MT 59601.

107

PROJECT TITLE: Reversion of Irrigated Lands (WELUT No. 053-75)

INVESTIGATOR/ORGANIZATION: David R. Anderson, Utah Coop. Wildlife Research Unit, Utah State Univ., Logan, UT 84321

FUNDING AGENCY: U.S. Dept. of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

DURATION: 6/75 - 6/77 (Completed)

LOCATION: Five WELUT Regional Environmental Test Areas in ND, WY, CO, UT, NM, and MT (MT area is southeastern part of state including part of Crow Indian Reservation and Powder River County).

DESCRIPTION: This study was designed to describe the vegetative successional responses and the related wildlife population changes on lands that revert from irrigated to nonirrigated status, a condition that may result as water is diverted from agricultural to energy uses. Because of limited data available for analysis a more limited goal will be achieved with the results available during the third year and publication of certain related studies.

PUBLICATIONS: (1) D.R. Anderson, E.C. Larsen, G.C. White. Succession on Irrigated Lands Reverted to Non-Irrigated Status: Final Report. June 1977. Utah Cooperative Wildlife Research Unit, Utah State Univ., Logan, UT.; (2) Report on evaluation of alternatives to the jackknife estimator for estimation of small mammal density; (3) Report on statistical estimation of plant biomass from quadrat data; (4) A documented computer program developed to analyze plant biomass data. Contact Hank Ash, Project Officer, Fish & Wildlife Service, WELUT, Federal Building, Fort Collins, CO 80521 for availability.

108

PROJECT TITLE: Rosebud Creek Benthic Invertebrate and Water Quality Study, Colstrip, Montana

INVESTIGATOR/ORGANIZATION: Robert E. Carroll, Ecological Consulting Service, 1300 Cedar, Helena, MT 59601, (406) 442-4650

FUNDING AGENCY: The Montana Power Company, Butte, Montana

DURATION: 6/75 - 1/76 (Completed) LOCATION: MT - Rosebud Co. (near Colstrip)

DESCRIPTION: A determination of the diversity and biomass of animal and plant life living on the river bottom of Rosebud Creek. Analysis of 25 parameters to establish water quality character of Rosebud Creek.

PUBLICATIONS: Final report to Montana Power Company.

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PROJECT TITLE: Rosebud Creek Study

INVESTIGATORS/ORGANIZATIONS: Al Elser, Mt. Dept. of Fish and Game, Box 430, Miles City, MT 59301, (406) 232-4365; Jim Schreiber, State Fish Hatchery, Route 1, Box 18, Lewistown, MT 59457, (406) 538-5588

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$34,000 DURATION: 9/75 - 12/76 (Completed)

LOCATION: MT - Rosebud and Big Horn Counties (Rosebud Creek)

DESCRIPTION: Objectives - (1) To determine species composition, distribution, diversity, and relative abundance of the aquatic biota of Rosebud Creek; and (2) To evaluate and predict the potential impacts of proposed coal development. (NOTE: This study is a sub-project of Toxic Effects on the Aquatic Biota from Coal and Oil Shale Development, Project No. 112.)

PUBLICATIONS: Final report available through the Fishery Bioassay Laboratory, Montana State University, Bozeman, MT 59715. April 1977.

110

PROJECT TITLE: Sarpy Basin Wildlife and Vegetation Study

INVESTIGATOR/ORGANIZATION: Peter Martin, Mt. Dept. of Fish and Game, Box 1017, Forsyth, MT 59327, (406) 356-2611

FUNDING AGENCY: Cormorant Corporation

FUNDING AMOUNT: Approx. \$10,000/year DURATION: 1/74 - Continuing

LOCATION: MT (Sarpy Basin)

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DESCRIPTION: Objectives - (1) To determine impact of future surface mining operations on wildlife resources; (2) To ensure that fish and wildlife habitat values receive full recognition in any reclamation efforts; and (3) To investigate possible modifications, additions, or innovations in surface mining reclamation processes to avoid unnecessary loss of wildlife habitat and develop techniques to enhance habitat through reclamation.

PUBLICATIONS: Peter Martin. Sarpy Basin Wildlife Ecology Study. Annual reports available at Montana State Library, Helena, MT 59601.

111

PROJECT TITLE: Statistical Analysis of Wildlife and Vegetative/Habitat in the 10 x 20 Area, Colstrip, Montana

INVESTIGATOR/ORGANIZATION: Robert E. Carroll, Ecological Consulting Service, 1300 Cedar, Helena, MT 59601, (406) 442-4650

FUNDING AGENCY: The Montana Power Company, Butte, MT

DURATION: 1/75 - 5/76 (Completed) LOCATION: MT - Rosebud Co. (Colstrip)

DESCRIPTION: A mathematical program to analyze wildlife and vegetative/habitat data in the 10 x 20 area.

PUBLICATIONS: Final report to Montana Power Company.

112

PROJECT TITLE: Toxic Effects on the Aquatic Biota from Coal and Oil Shale Development (EPA-WQO No. R803950)

INVESTIGATORS/ORGANIZATIONS: Robert V. Thurston and Rosemarie C. Russo, Fisheries Bioassay Laboratory, Montana State Univ., Bozeman, MT 59715, (406) 994-3371; Rodney K. Skogerboe, Natural Resource Ecology Laboratory, Colorado State Univ., Fort Collins, CO 80523

FUNDING AGENCY: U.S. Environmental Protection Agency, Environmental Research Laboratory, Duluth, MN

FUNDING AMOUNT: \$1,700,000 (FY77 \$550,000) DURATION: 7/75 - 6/78

LOCATION: Western coal and oil shale development areas

DESCRIPTION: The overall objective of this investigation is to provide predictive information with regard to potential toxicants to the aquatic environment resulting from coal and oil shale extraction and conversion. The specific objectives are to identify and quantify those chemical products of coal and oil shale extraction and conversion which may reach surface waters, and to determine by both field studies and laboratory bioassays the degree to which those chemicals may be acutely or chronically toxic to fish and aquatic invertebrates, or may become involved as part of the food chain. Four categories of energy

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development will be considered: coal extraction, oil shale extraction and processing, coal gasification, and coal-to-energy conversion.

PUBLICATIONS: Quarterly and Annual Progress Reports. Contact investigators for availability.

113

PROJECT TITLE: Wildlife and Wildlife Habitat Baseline and Monitoring of Big Sky Mine

INVESTIGATOR/ORGANIZATION: Robert E. Carroll, Ecological Consulting Service, 1300 Cedar, Helena, MT 59601, (406) 442-4650

FUNDING AGENCY: Peabody Coal Company, St. Louis, MO

DURATION: 6/76 - Continuing

LOCATION: MT - Rosebud Co.

DESCRIPTION: Objective - To obtain four-season baseline of wildlife and wildlife habitat at Big Sky Mine and monitoring wildlife and habitat parameters annually.

PUBLICATIONS: Annual reports to Peabody Coal Company are filed with the Mt. Dept. of State Lands, Helena, MT 59601.

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PROJECT TITLE: Wildlife and Wildlife Habitat Baseline and Monitoring Tract III

INVESTIGATOR/ORGANIZATION: Robert E. Carroll, 1300 Cedar, Helena, MT 59601, 406) 442-4650

FUNDING AGENCY: Westmoreland Resources

DURATION: 6/73 - 7/76 (Completed)

LOCATION: MT - Big Horn County (Sarpy Creek)

DESCRIPTION: Objective - To obtain four-season baseline of wildlife and wildlife habitat on Tract III and monitoring wildlife and habitat parameters annually.

PUBLICATIONS: Final report to Westmoreland. Filed with the Mt. Dept. of State Lands, U.S. Geological Survey, and the U.S. Bureau of Indian Affairs.

COAL

1.3 COMPREHENSIVE STUDIES

(INCLUDING ENVIRONMENTAL IMPACT STATEMENTS)

COAL/Comprehensive Studies

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PROJECT TITLE: Baseline and Postmining Environmental Considerations Associated with a Coal Surface Mining Operation in Southeastern Montana

INVESTIGATORS/ORGANIZATION: Edward J. DePuit, Richard L. Hodder, Dept. of Animal and Range Sciences, Montana Agric. Exp. Station, Montana State Univ., Bozeman, MT 59715, (406) 994-4821

FUNDING AGENCY: Shell Oil Company, Houston, TX

FUNDING AMOUNT: \$135,730 (FY77 \$55,138)

DURATION: 7/75 - 6/78

LOCATION: MT - Crow Coal Lease

DESCRIPTION: Studies to date have been primarily concerned with collection of baseline biological and physical data from an extensive potential coal surface mining area in southeastern Montana, including information on vegetation, watershed condition, wildlife and air quality. An intensive analysis of overburden (i.e. potential spoil) material has also been conducted. These data will be used in future studies to determine and test reclamation priorities and procedures, and also to monitor the impact of mining, should it occur, on the environment of the surrounding area. Most significant of these latter studies include an evaluation of the effect of mining activity on area wildlife populations (conducted in cooperation with the U.S. Fish and Wildlife Service) and a study of the impact of a coal mine railroad spur line on the surrounding environment.

PUBLICATIONS: Numerous progress reports to Shell Oil Company in various stages of preparation for publication as MAES Research Reports.

116

PROJECT TITLE: Beartooth Coal Company's Proposed Reopening of Brophy Coal Mine -- Environmental Impact Statement

INVESTIGATOR/ORGANIZATION: JoAnn E. Vorozilchak, Dept. of State Lands, Capitol Station, Helena, MT 59601, (406) 449-2074

FUNDING AGENCY: No arrangement yet.

DURATION: 1/77 - uncertain

LOCATION: MT - Carbon County (Bearcreek, Red Lodge area)

DESCRIPTION: Beartooth Coal Company wishes to reopen the Brophy Mine, an underground operation that was closed in 1957. Eventually Beartooth would like to reactivate other mines, both strip and underground, in the area. Old analysis of the Brophy coal showed a BTU content of 10,840 and a sulfur content of 1.2%. This coal could be used by Montana industries that must switch from natural gas and have SO_x flue gas scrubbers. The heating value is higher than the Eastern Montana coals. The mining would benefit Carbon County through employment opportunities and taxes; but skilled underground coal miners are lacking. Safety is a major consideration in re-opening old mines. Environmental protection is another major concern including air and water quality, subsidence, potential historic values, etc.

COAL/Comprehensive Studies

117

PROJECT TITLE: The Bioenvironmental Impact of a Coal-Fired Power Plant

INVESTIGATOR/ORGANIZATION: Eric M. Preston, Corvallis Environmental Research Laboratory, U.S. Environmental Protection Agency, 200 SW 35th Street, Corvallis, OR 97330, (503) 752-4211

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: FY75 \$700,000; FY76 \$900,000; FY77 \$830,000

DURATION: 6/74 - 7/80

LOCATION: MT - Rosebud Co. (Colstrip)

DESCRIPTION: This is an interdisciplinary approach designed to assess the effects of coal-fired power plants upon a grassland ecosystem. The principal objective of this program is to develop an impact assessment protocol with a truly predictive potential. This protocol will be designed with a view to allow rational siting decisions to be made before damage to the environment is actually sustained. Major project elements are the study of lichens as indicators and predictors of pollution; of air quality and meteorology; ecosystem and diffusion modeling; studies of plant community structure; primary and secondary producers; plant and animal disease; remote sensing; field and laboratory studies in most of the above areas; project synthesis and integration.

PUBLICATIONS: The Bioenvironmental Impact of a Coal-Fired Power Plant, First Interim Report, December 1974; Second Interim Report, June 1975; Third Interim Report, In press.

118

PROJECT TITLE: Circle West Baseline Study

INVESTIGATOR/ORGANIZATION: Bob Anderson, Energy Planning Division, Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601, (406) 449-3780

FUNDING AGENCY: Dreyer Bros, Inc. (a wholly-owned subsidiary of Burlington-Northern)

FUNDING AMOUNT: Not finalized

DURATION: 1/76 - Uncertain. Wildlife and vegetation studies for the McCone Co. site have been initiated. Other baseline studies have been postponed until the other potential sites for this project have been determined.

LOCATION: Potential sites are the Great Falls area, Glasgow Air Force Base, the Wolf Point-Oswego area and the McCone County-Circle West area.

DESCRIPTION: During mid-1974, Dreyer Brothers, Inc., notified the State of its intention to develop a coal processing facility in McCone County, MT. Since that time other sites have been considered. Under the Montana Major Facility Siting

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Act, the Dept. of Natural Resources is required to do a study of the alternative sites. The long-range plans for the Circle Project include: a strip mining operation that would produce six millions tons of coal a year and a diesel fuel oil plant to produce 30,000 barrels a day. The ammonia would be shipped elsewhere for conversion into fertilizer. The diesel fuel would be used for Burlington Northern's trains. Coal for the project would come from the Dreyer Bros. Ranch near Circle. The necessary water would come from the Missouri River or Fort Peck Reservoir.

PUBLICATIONS: Wildlife and vegetation baseline studies for the McCone County-Circle West area are nearly complete.

119

PROJECT TITLE: Crow Ceded Area Coal Lease, Tracts II and III, Westmoreland Resources -- Environmental Impact Statement

INVESTIGATOR/ORGANIZATION: David Pennington, U.S. Department of the Interior, Bureau of Indian Affairs, 316 N. 26th Street, Billings, MT 59101, (406) 657-6145

FUNDING AGENCY: U.S. Dept. of the Interior, Bureau of Indian Affairs

FUNDING AMOUNT: Approx. \$85,000 DURATION: 1/76 - 12/76 (Completed)

LOCATION: MT - Big Horn County

DESCRIPTION: The purpose of this environmental impact statement is to describe reasonable projections of the environmental effects of developing Crow Tribal coal resources on two tracts of land presently under lease to Westmoreland Resources. This statement studied probable effects of coal development on a leasehold totalling approximately 30,786 acres within the Ceded Area of the Crow Indian Reservation. It does not address any site-specific mining and reclamation plan. The statement analyzes overall and cumulative effects over three levels of time and development. The third level of development includes a discussion of energy conversion at a hypothetical nearby facility in addition to mining for rail transport.

PUBLICATIONS. Draft EIS issued August 17, 1976. Final EIS issued December 15, 1976. Available from the Bureau of Indian Affairs, Billings Area Office, 316 N. 26th Street, Billings, MT.

120

PROJECT TITLE: East Decker and North Extension Mines, Decker Coal Company, Big Horn County, Montana -- Proposed Plan of Mining and Reclamation -- Environmental Impact Statement

INVESTIGATORS/ORGANIZATIONS: Brace Hayden, State Team Leader, Mt. Dept. of State Lands, Helena, MT 59601, (406) 449-2074; U.S. Geological Survey

FUNDING AGENCIES: U.S. Department of the Interior, Geological Survey; State of Montana; Decker Coal Company

COAL/Comprehensive Studies

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FUNDING AMOUNT: Approx. \$300,000 (USGS \$200,000; Decker \$65,000; State of Montana \$35,000)

DURATION: 5/75 - 6/77 (Completed)

LOCATION: MT - Big Horn County

DESCRIPTION: State and Federal action on proposed surface-mining and reclamation plans, East Decker and North Extension Mines, Decker Coal Company, Big Horn County, Montana. Company proposes opening a new mine complete with plant and loading facilities and railroad spur in the East Decker area and opening a major northern expansion of the existing West Decker Mine that would use existing East Decker Mine facilities. To facilitate mining, the Company also proposes relocating short sections of a Federal-aid-secondary highway and an unpaved county road. An estimated 180 million tons of low-sulfur coal would be removed from an area of about 3,500 acres over a period of about 20 years and shipped to Illinois, Michigan, and Texas for use in electric-power generation plants.

PUBLICATIONS: Draft EIS issued October 29, 1976; Final EIS issued June 13, 1977.

121

PROJECT TITLE: An Evaluation of the Environmental Impact of the Existing Surface Mining Methods for Western Coal Mines (EPA No. 68-03-2226)

INVESTIGATORS/ORGANIZATIONS: William S. Kelly, Mathtech Division, Mathematica, Inc., P.O. Box 2392, Princeton, NJ 08540, (609) 799-2600; Peter Briggs, Hittman Associates, 9190 Red Branch Road, Columbia, MD 21045, (301) 730-7800

FUNDING AGENCY: U.S. Environmental Protection Agency, Environmental Research Center, Cincinnati, OH

FUNDING AMOUNT: \$173,000

DURATION: 7/75 - 9/77 (Completed)

LOCATION: MT, WY, ND, CO, NM

DESCRIPTION: The objectives of this study are two-fold. The first is to assess the environmental damages that result from strip mining in the western coal fields and to rank them in order of severity. This assessment is based upon direct observations of nine western mines, supplemented by literature surveys and personal interviews. The second objective is to identify new production/reclamation planning, operating and equipment concepts whose use would reduce environmental damage, and to evaluate the economic and environmental costs and benefits and the engineering practicability of those concepts.

PUBLICATIONS: Final report has been completed and forwarded to EPA-Cincinnati.

122

PROJECT TITLE: Glasgow Air Force Base Energy Facilities Siting Study

INVESTIGATOR/ORGANIZATION: Don L. Brelsford, Montana Energy and MHD Research and Development Institute, P.O. Box 3809, Butte, MT 59701, (406) 494-4569

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FUNDING AGENCY: U.S. Federal Energy Administration

FUNDING AMOUNT: Approx. \$94,000 DURATION: Completed 11/75

LOCATION: MT - Valley County (Glasgow Air Force Base, 18 miles N of Glasgow)

DESCRIPTION: The objective of this study was to develop an impact and suitability profile for the use of the Glasgow Air Force Base in northeastern Montana as an energy center, and to provide an analysis and recommendations on the size and type of energy center components that could be accommodated. The close proximity of Glasgow AFB to the substantial Fort Union coal resources, along with the increasing regional shortage of natural gas and crude oil supplies, indicates that fossil-fuel conversion into needed synthetic fuels is probably the more advantageous use of this site and the large quantities of available water in the upper Missouri Basin. Beyond the ordinary preliminary assessments of environmental impacts on air, water, land and human resources, the study included considerations of construction and operation of a coal-fueled energy center. Representative types and sizes of energy conversion plants were examined, along with a variety of process options. These analyses indicate, generally, that Glasgow AFB has substantial suitability for development into a coal-fueled, energy conversion facility complex. Environmental impact of energy conversion would be the major limiting factor to the scope and extent of an energy center plan at Glasgow AFB.

PUBLICATIONS: Siting Energy Facilities at Glasgow Air Force Base, Executive Summary, November 1975 (FEA/G-75/418); Volume I (FEA/G-75/419); Volume II (FEA/G-75/420); Volume III (FEA/G-75/421)

123

PROJECT TITLE: Montana Coal Development Information Project (DHEW No. 8/74-0049)

INVESTIGATORS/ORGANIZATION: John Goers, Theodore H. Clack, Jr., Montana Energy Advisory Council (now the Mt. Energy Office), Helena, MT 59601, (406) 449-3940

FUNDING AGENCY: U.S. Department of Health, Education and Welfare

FUNDING AMOUNT: Approx. \$4,000 DURATION: 7/74 - 7/75 (Completed)

LOCATION: MT - Statewide

DESCRIPTION: Purpose - To provide summary information to all Montanans interested in or concerned about existing and potential development of the Fort Union coal deposits of Eastern Montana. In July 1974, the Montana Energy Advisory Council prepared a Coal Development Information Packet which provided a broad data base useful in considering future impacts of coal and energy development in Montana. As a supplement to this study, MEAC collected information on the "socio-economic" aspects of energy development and published a summary of this material. The information which was assembled is continually being updated by MEAC (now the Montana Energy Office).

PUBLICATIONS: Coal Development Information Packet, December 1974; Supplement I, July 1975. Available from the Montana Energy Office, Helena, MT 59601.

COAL/Comprehensive Studies

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PROJECT TITLE: Proposed MONTCO Coal Strip Mine - Environmental Impact Statement

INVESTIGATOR/ORGANIZATION: David Janis, Mt. Dept. of State Lands, Helena, MT 59601, (406) 449-2074

FUNDING AGENCY: MONTCO

DURATION: 4/77 - 1980

FUNDING AMOUNT: Will be funded by MONTCO. Amount not determined at this time.

LOCATION: MT - Rosebud County (Somewhere along east side of Tongue River across from the Northern Cheyenne Indian Reservation.)

DESCRIPTION: MONTCO proposes to open a new coal strip mine somewhere along the east side of the Tongue River across from the No. Cheyenne Indian Reservation. The exact location of the new mine is unknown at this time, and is partly dependent on a proposed railroad spur.

PUBLICATIONS: An EIS will be issued by the Mt. Department of State Lands.

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PROJECT TITLE: Natural Resource Use and Environmental Impact Study of Western Coal Development

INVESTIGATOR/ORGANIZATION: Stephen G. Miller, Thomas E. Carroll Associates, 1700 Pennsylvania Ave, NW, Suite 630, Washington, D.C. 20006

FUNDING AGENCY: Old West Regional Commission

FUNDING AMOUNT: \$60,000

DURATION: 2/74 - 9/74 (Completed)

LOCATION: MT, WY, ND, SD

DESCRIPTION: Because of the growing demand for coal in the U.S. and the abundance of stripmineable coal in Montana, Wyoming and the Dakotas, the contract's purpose was to examine more desirable process alternatives. Since little was known of such alternative processes, other than their technological feasibility, contractor examined the impact in terms of direct environmental, land disturbance, water use and associated factors, plus indirect impacts of population growth, economic consequences and quality of life considerations.

PUBLICATIONS: Environmental Impacts of Alternative Conversion Processes for Western Coal Development. October 25, 1974. Submitted to the Old West Regional Commission, 1730 K St, NW, Washington, D.C. by Thomas E. Carroll Associates.

126

PROJECT TITLE: Northern Powder River Basin Regional Environmental Impact Statement

INVESTIGATORS/ORGANIZATIONS: This is a joint state-federal EIS. David Stiller, State Team Leader, Room 221, Power Block, Helena, MT 59601, (406) 449-2711. Glen Malmberg, Federal Team Leader, U.S. Geological Survey, Billings Office.

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FUNDING AGENCY: Old West Regional Commission

FUNDING AMOUNT: \$293,000

DURATION: 10/76 - 2/79

LOCATION: MT - Big Horn, Rosebud, Powder River, Custer, and Treasure Counties

DESCRIPTION: In an innovative approach to the preparation of an environmental impact statement, the State of Montana and the U.S. Department of the Interior, Geological Survey, have reached an agreement for a joint effort in the preparation of a regional environmental impact statement for anticipated coal development in the No. Powder River Region of Montana. This cooperative effort assures the state full exercise of jurisdictional authority pertaining to both resource development and environmental protection concerns of the state and the region. The regional environmental impact statement will be an important tool for decision making, particularly with respect to the leasing of federal coal minerals under private surface. The objectives of the grant will be: (1) To ensure full and timely state participation in federal planning processes which will affect the nature and timing of energy development in the Northern Powder River Basin of Montana; (2) To provide a basis for federal decisions which will mitigate potential adverse social, economic, and environmental impacts in southeastern Montana, particularly through cooperative measures with the state of Montana; (3) To provide a basis for federal coal leasing decisions which will fully respect the state's paramount responsibility for the welfare of the people and resources of Montana, and hence add a significant component to the realization of land use and resource planning processes in Montana.

PUBLICATIONS: An EIS will be issued by the State of Montana and the U.S. Department of Interior, Geological Survey.

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PROJECT TITLE: Peabody Coal Company's Big Sky Mine Extension -- Environmental Impact Statement

INVESTIGATOR/ORGANIZATION: David Janis, Mt. Department of State Lands, Helena, MT 59601, (406) 449-2074

FUNDING AGENCY: Peabody Coal Company will be assessed a fee.

FUNDING AMOUNT: Not determined.

DURATION: 12/77 - uncertain

LOCATION: MT - Rosebud County

DESCRIPTION: Peabody Coal Company is proposing to extend its present coal strip mine (Section 22) into Sections 13, 14, 15, 23, and 24. This action requires the preparation of an environmental impact statement.

PUBLICATIONS: An EIS will be issued by the Department of State Lands.

COAL/Comprehensive Studies

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PROJECT TITLE: Poplar River Basin Study

INVESTIGATOR/ORGANIZATION: Ronald J. Schleyer, Montana Environmental Quality Council, Helena, MT 59601, (406) 449-3742

FUNDING AGENCY: State of Montana (Environmental Quality Council)

DURATION: 9/76 - 10/76 (Completed)

LOCATION: MT - Poplar River Basin

DESCRIPTION: This study reviewed the impacts on northeastern Montana of the coal-conversion developments of the Saskatchewan Power Corporation. On September 11, 1974, the Province of Saskatchewan announced plans for the first stage of a 1,200-million watt coal-fired electric power complex to be erected in southern Saskatchewan near the international border with Montana. A strip mine, dam and reservoir for cooling water and the first of four 300-million watt generating stations were to be built in the headwaters drainage of the East Fork of the Poplar River. This study concerned itself with the people, land and economy of the Poplar River Basin, water rights issues, industrial and agricultural development, the Boundary Water's Treaty, and Montana environmental degradation from the proposed development.

PUBLICATIONS: Ronald J. Schleyer. The Transboundary Effect: Safeguarding the Poplar River in Montana, An EQC Staff Report, October 6, 1976 (out of print)

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PROJECT TITLE: Poplar River Study

INVESTIGATORS/ORGANIZATIONS: Bob Hagen, Project Officer, U.S. Environmental Protection Agency, 1860 Lincoln Street, Denver, CO 80295; Bill Christiansen, Montana Energy Office, Helena, MT 59601; George Pike, U.S. Geological Survey; Norman Glass, U.S. EPA, Corvallis Environmental Research Center, Corvallis, OR. Other agencies participating in the project are: Montana Dept. of Health and Environmental Sciences, Air Quality Bureau; Montana Dept. of Natural Resources and Conservation, Water Resources Division; Montana Dept. of Fish and Game, Ecological Services Division; and the Fort Peck Tribe.

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$400,000

DURATION: 1/77 - Continuing

LOCATION: MT - Valley, Roosevelt, Sheridan, and Daniels Counties (Poplar River Basin)

DESCRIPTION: The Saskatchewan Power Corporation is building a 300-megawatt electric power generating station near Coronach, Sask., about 30 miles northwest of Scobey on the East Fork of the Poplar River. Construction and operation of this plant, the first of four such plants that Canadian firms may build on the Poplar, is causing concern about possible degradation to the environment in the U.S. The units will use lignite, which is abundant in the area, for power generation and will be cooled by water from a 32,000 acre-feet capacity reservoir on the East Poplar River. The Environmental Protection Agency has initiated a

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study of the Poplar River Basin which will include the following components: (1) Soils analysis, upper air meteorology, coal analysis, baseline ambient air quality, vegetation, and visibility components to be conducted by the Air Quality Bureau, Montana Dept. of Health and Environmental Sciences; (2) Fish and furbearer studies to be conducted by the Montana Dept. of Fish and Game; (3) Water quality modeling effort to be conducted by the Mt. Dept. of Health and Environmental Sciences, Water Quality Bureau; (4) Water use component to be conducted by the Water Resources Division, Mt. Dept. of Natural Resources and Conservation; (5) Ground water and surface water monitoring to be conducted by the U.S. Geological Survey; (6) Vegetation effects research to be conducted by EPA's Corvallis Environmental Research Laboratory; (7) A water use component which will describe the future and existing water use on tribal land will be undertaken by the Fort Peck Tribe; and (8) Remote sensing land use mapping will be undertaken by EPA's Las Vegas Laboratory. The Environmental Protection Agency will be integrating the effort so as to provide support for the EIS process dictated under NEPA as well as to provide alternative air pollution control strategies.

PUBLICATIONS: The data integrated from this study will produce two reports: One report will assess environmental impact of air and water pollution to the U.S. emanating from the coal-fired power plant at Coronach. The second report will consider alternative air control strategies that could be implemented by the Canadians so as to reduce the amount of sulfates and particulates carried across the U.S. border from Canada.

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PROJECT TITLE: Proposed Federal Coal Leasing Program

INVESTIGATOR/ORGANIZATION: Curt Burklund, Director, Bureau of Land Management, U.S. Department of the Interior, 18th and C Streets, NW, Washington, D.C. 20240, (202) 343-7180

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Land Management

DURATION: 2/73 - 9/75 (Completed)

LOCATION: Nationwide, including No. Great Plains coal regions.

DESCRIPTION: Action - Lift moratorium and resume coal leasing by the Bureau of Land Management, utilizing the Energy Minerals Activity Recommendation System. The program involves some 85 million acres of identified coal reserves located primarily in the No. Great Plains and northward along the continental divide from New Mexico and Arizona through Montana. Action will include existing preference right lease applications, plus future competitive sales.

Summary of Environmental Impacts - Extraction of coal from leased Federal lands creates a wide range of social, economic, and environmental impacts. Surface disturbance ranges from the extreme during surface mining to the minimal associated with mine mouth operation. Surface mining results in temporarily drastic topographic, vegetational, and ecological alterations. (NOTE: The U.S. Dept. of the Interior is now in the process of preparing a new final coal programmatic EIS in order to comply with a directive by the U.S. District Court on September 27, 1977. The Court concluded that the final programmatic EIS filed in 1975 on the federal coal leasing program was inadequate.

COAL/Comprehensive Studies

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PUBLICATIONS: Draft EIS issued May 9, 1974. Final EIS issued September 19, 1975. For sale by the Sup. of Documents, \$5.20, Stock No. 024-011-00062-3.

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PROJECT TITLE: Shell Oil Company's Proposed Pearl Coal Mine - Environmental Impact Statement

INVESTIGATOR/ORGANIZATION: Sandra Johnson, Mt. Department of State Lands, Helena, MT 59601, (406) 449-2074

FUNDING AGENCY: Shell Oil Company Mining Ventures

FUNDING AMOUNT: \$60,000

DURATION: 7/77 - 7/78

LOCATION: MT - Big Horn County; WY - Sheridan County

DESCRIPTION: Shell Oil Company proposes to open a truck and shovel operation, mining about 2 million tons of coal per year and shipping about 4.4 unit trains a week.

PUBLICATIONS: An EIS is being prepared and will be available in 1978.

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PROJECT TITLE: Simulation Modeling of Environmental and Social Impacts of Coal Development in the Powder River Basin

INVESTIGATORS/ORGANIZATION: Robert Mark, David Harwood, U.S. Dept. of the Interior, Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025, (415) 323-8111

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey

FUNDING AMOUNT: FY77 Approx.\$135,000

DURATION: 1/75 - 9/78

LOCATION: MT, WY - Powder River Basin

DESCRIPTION: The purpose of this study is to create a system dynamics simulation model of environmental and social impacts of coal development in the Powder River Basin. The model will be computerized and will make use of several development scenarios - those of the Northern Great Plains Resources Program, as well as other input scenarios.

PUBLICATIONS: Robert Mark, David Harwood, Richard Doell. A Role for Simulation Modeling in the EIS Process: A Western Coal Region Example. In preparation, USGS, Menlo Park, CA 94025

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PROJECT TITLE: Spring Creek Coal Company's Proposed Coal Strip Mine --
Environmental Impact Statement

INVESTIGATOR/ORGANIZATION: Craig Howard, Montana Department of State Lands,
Helena, MT 59601, (406) 449-2074; U.S. Geological Survey

FUNDING AGENCY: NERCO, Inc.

FUNDING AMOUNT: \$65,000 (FY77 \$30,000)

DURATION: 5/76 - 6/78

LOCATION: MT - Big Horn County; WY - Sheridan County

DESCRIPTION: Spring Creek Coal Company proposes to open a new coal strip mine in Big Horn County, Montana. This mine would produce coal at a rate of 10 million tons per year at full production. The Mt. Department of State Lands and the U.S. Geological Survey have determined that an EIS is necessary. These agencies are presently engaged in the process of preparing such an EIS on a joint basis.

PUBLICATIONS: (1) Spring Creek Coal Co. Permit Application, Vols. 1-6; (2) Spring Creek Coal Co. Environmental Baseline, Vols. 1-2. These publications can be obtained through the Mt. Dept. of State Lands, Helena, MT 59601.

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PROJECT TITLE: Underground Coal Production, Roundup Mine

INVESTIGATORS/ORGANIZATIONS: Ralph Gildroy, Central Montana District Six Council, Box 302, Roundup, MT 59072, (406) 323-2547; Glenn Johnson, Western Coal Co., 803 1st St. W, Roundup, MT 59072, (406) 323-2547

FUNDING AGENCY: In house - Central Mt. District Six Council

DURATION: 12/75 - 6/76 (Completed)

LOCATION: MT - Musselshell County (Bull Mountain Coal Field)

DESCRIPTION: Problem - Negative environmental impact of surface mining of the mammoth vein of the Bull Mountain Coal Field. State law pertinent to contour strip mining is a deterrent to any surface mining. In addition, some county residents engaged in agriculture fear surface disturbances may have deleterious effects on farming and ranching operations. Objectives - Minimize negative environmental impact. Investigate feasibility of underground coal mining operations in Bull Mountain field. Approach - Explore leasing potentials, mineral ownerships, mine entry locations, establish distances and costs to rail head, estimated production, type of production, underground and surface requirements and equipment, personnel, wage and fringe, number of shifts, operating costs, total costs and cost per ton at mine site and on rail, estimated tonnage per acre, analyses of two coal seams, preliminary consideration of mining three coal seams.

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PROJECT TITLE: Water for Energy, Missouri River Reservoirs -- Environmental Impact Statement

INVESTIGATOR/ORGANIZATION: Dean Loomis, U.S. Department of the Interior, Bureau of Reclamation, P.O. Box 2553, Federal Building, Billings, MT 59103, (406) 657-6214

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Reclamation

DURATION: Completed 12/77

LOCATION: Eastern MT, Western ND, Western & Central SD, Northeastern WY

DESCRIPTION: Pursuant to the National Environmental Policy Act of 1969, the U.S. Department of Interior has prepared an environmental impact statement describing the environmental impacts which could be expected if 1 million acre-feet of water is diverted from Missouri River Reservoirs for energy-related industrial development. The statement covers impacts of depletion of the water from the mainstem reservoir system and development and operation of a hypothetical mixture of industries and associated coal mining in eastern Montana, western North Dakota, western and central South Dakota, and northeastern Wyoming.

PUBLICATIONS: A final environmental impact statement was issued on December 6, 1977. Available from the Bureau of Reclamation, Billings, MT 59103.

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PROJECT TITLE: Western Energy Company's Proposed Expansion of Rosebud Mine Into Area B - Environmental Impact Statement

INVESTIGATOR/ORGANIZATION: Brace Hayden, Mt. Dept. of State Lands, Helena, MT 59601, 406-449-2074

FUNDING AGENCY: State of Montana (Dept. of State Lands)

FUNDING AMOUNT: Approx. \$5,000 DURATION: 2/76 - 6/76 (Completed)

LOCATION: MT - Rosebud County (Colstrip)

DESCRIPTION: Western Energy Company is seeking to expand their mine into a new mining area entitled Area B. Area B is located approximately one mile to the southwest of Colstrip. Specifically WECO wants to permit 1,176 acres: (1) 491.22 acres for strip mining or spoiling; (2) 107.04 acres for haul roads and facilities; and (3) 577.02 acres for associated disturbance. Included in the permit application is a request for a dragline corridor to move one of WECO's draglines across Armells Creek.

PUBLICATIONS: Final EIS issued July 26, 1976.

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PROJECT TITLE: Western Regional Energy Development Study: Primary Environmental Impacts

INVESTIGATOR/ORGANIZATION: F. Scott La Grone, Radian Corporation, P.O. Box 9948, Austin, TX 78766

FUNDING AGENCIES: U.S. Council on Environmental Quality, U.S. Energy Research and Development Administration, U.S. Environmental Protection Agency, U.S. Federal Energy Administration, U.S. Department of Interior, U.S. National Science Foundation

FUNDING AMOUNT: \$171,864 DURATION: 3/74 - 3/75 (Completed)

LOCATION: MT, AZ, CO, NM, ND, UT, WY

DESCRIPTION: Purpose - To examine the primary environmental impacts of 38 energy resources development scenarios. Including air and water emission, solid waste and land requirements. Projections are also made of ground level ambient concentrations of pollutants. These projections are compared with federal and state air quality standards. The scenarios include all aspects of development - extraction, conversion, and transportation to point of end use. The study also surveys the energy resources of AZ, CO, MT, NM, ND, and WY. It estimates energy demand patterns in several cities and discusses water requirements, energy efficiency and technological feasibility of different scenarios.

PUBLICATIONS: Executive Summary (PB 246-267); Vol. I (PB 246-264); Vol. II (PB 246-265); Appendices (PB 246-266). Available from NTIS, Springfield, VA.

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PROJECT TITLE: Westmoreland Resources Proposed Expansion of Absaloka Coal Mine Into Section 36 - Environmental Impact Statement

INVESTIGATOR/ORGANIZATION: David Janis, Mt. Department of State Lands, Helena, MT 59601, (406) 449-2074

FUNDING AGENCY: Westmoreland Resources, Inc.

FUNDING AMOUNT: Has not been calculated. DURATION: 6/76 - 12/77 (Completed)

LOCATION: MT - Big Horn County (within Crow Reservation)

DESCRIPTION: Westmoreland Resources is seeking to expand their Absaloka coal strip mining operation south into Section 36. This has required an EIS to be written.

PUBLICATIONS: Draft EIS issued on June 24, 1977; Final EIS issued on December 23, 1977.

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PROJECT TITLE: Northern Cheyenne Research Project

INVESTIGATOR/ORGANIZATION: Richard Monteau, Northern Cheyenne Research Project, P.O. Box 388, Lame Deer, MT 59043, (406) 477-6278

FUNDING AGENCIES: The No. Cheyenne Research Project has received and managed \$1,601,000 in funding since its inception in 1973. Funding agencies have included: U.S. Department of Health, Education and Welfare, Office of Native American Programs; U.S. Environmental Protection Agency; Old West Regional Commission; U.S. Department of the Interior, Bureau of Indian Affairs; etc.

FUNDING AMOUNT: \$1,601,000 (FY73 \$125,000, FY74 \$200,000, FY75 \$419,000, FY76 \$501,000, FY77 \$356,000)

DURATION: 1973 - Continuing

LOCATION: MT (Northern Cheyenne Reservation)

DESCRIPTION: The Northern Cheyenne Indian Reservation is located in Southeastern Montana, in the heart of the Fort Union Coal Formation. The reservation covers some 447,000 acres and is underlain by approximately 23 billion tons of low sulfur sub-bituminous coal. In the late 1960s and 1970s the reservation area underwent intensive exploration by major energy companies. These companies and individual speculators attempted to gain control of mineral rights to over half of the Northern Cheyenne land base. In response to this situation the Northern Cheyenne Tribal Council established the Northern Cheyenne Research Project in 1973. The Project's purposes are to: (1) Coordinate programs among tribal, state and federal agencies to assess energy impacts; (2) Promote positive attitudes that will enable the survival of the Northern Cheyenne people as an ethnic group; and (3) Insure tribal identity and sovereignty. From 1973 to 1975 the No. Cheyenne Research Project (NCRP) collected available resource data and developed a public information program which addressed the potential impacts of energy development. In 1974 it was realized that existing information was inadequate to accurately assess the specific impacts of energy development on the resources of the Northern Cheyenne people. Scientific studies of the tribe's mineral, water and social-economic resources were begun in 1975 to provide the necessary pre-development or baseline data. Since 1975 the amount of information gathered has steadily increased, and in early 1977 the Research Project developed the capability to produce completed data analyses. The Tribe now regularly uses this research for information and planning purposes. The principal goal of the NCRP in 1977 is still to assist the tribe in the exercise of tribal sovereignty over its resources. Three specific objectives are proposed to achieve this goal: (1) To inventory tribal resources including social, economic, cultural, water, mineral, land base, vegetative, wildlife and air; (2) To develop and assist in the implementation of management plans for tribal resources; (3) To continually assess all local, state and national laws, codes and policies that might affect control over reservation resources and to take all necessary steps, under tribal direction, to assure tribal sovereignty.

PUBLICATIONS: (1) Land resource data (maps, photography, samples, etc.) available at the NCRP office. (2) The Northern Cheyenne Air Quality Redesignation Report and Request, 1977. (3) Population demographics, population projections, education figures, employment and unemployment figures, occupation and wage figures available at NCRP office. (4) Final Report to Old West Regional Commission, The Northern Cheyenne Tribe and Energy Development in Southeastern Montana: Social, Cultural, and Economic Investigations.

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PROJECT TITLE: Colstrip Electric Generating Units 3 and 4, 500 Kilovolt Transmission Lines from Colstrip to Hot Springs, Montana, and Associated Facilities -- Environmental Impact Statement

INVESTIGATOR/ORGANIZATION: Albert C. Tsao, Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601, (406) 449-3780

FUNDING AGENCY: Application fee from Montana Power Company, Puget Sound Power and Light Company, Portland General Electric Company, Pacific Power and Light Company, and Washington Water Power Company

FUNDING AMOUNT: \$1,188,668

DURATION: 6/73 - 1/75 (Completed)

LOCATION: MT - Rosebud County (Colstrip), and transmission line corridor extending from Colstrip to Hot Springs, MT

DESCRIPTION: In accordance with the Utility Siting Act, an application was jointly submitted by five utility companies with the Montana Dept. of Natural Resources and Conservation on June 6, 1973, for permission to construct two 700 megawatt electrical generating units to be located at Colstrip; the associated facilities of the units, and two 500 kilovolt transmission lines with accompanying terminal equipment extending from Colstrip to Hot Springs, MT.

PUBLICATIONS: A six-volume Draft Environmental Impact Statement was issued in November 1974: Volume I, Summary; Volume, Methodology, Need, and Alternatives; Volumes 3A and 3B, Power Plant; and Volume 4, Transmission Line. A final environmental impact statement was issued in January 1975.

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PROJECT TITLE: The Impact of Coal Development in the Fort Union Basin, Montana and Neighboring States

INVESTIGATOR/ORGANIZATION: Arnold J. Silverman, Department of Geology, University of Montana, Missoula, MT 59801, (406) 243-5151; Other investigators included Thomas M. Power, Univ. of Montana, Richard Stroup, Montana State Univ., Robert Curry, Univ. of Montana, W. Mark Weber U of M, Gene F. Payne, MSU, John E. Taylor, MSU, John Duffield, U of M.

FUNDING AGENCY: U.S. National Science Foundation, RANN

FUNDING AMOUNT: \$175,000

DURATION: 5/75 - 12/76 (Completed)

LOCATION: Eastern MT

DESCRIPTION: Over the next 5-10 years a marked increase in coal mining and power generation will occur in eastern Montana. Montana is well suited for studying the environmental effects of this increased industrialization because the area is still in a nearly pristine state, hence environmental assessment can be meaningful. A measure of the impact on the environment, however, can be achieved only if pre-industrial (base-line) data are available. The goal of this research is to undertake a program of gathering biophysical base-line

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data which are needed for the environmental assessment. These base-line studies will focus on hydrology, water resources, land use as related to present ecosystems, and remote sensing as a means of monitoring land changes. Most of this work will be accomplished by going into the field to gather data. In addition to the biophysical program, one study will involve economic projections of coal mining and power generation activities in eastern Montana. These projections will provide the framework for future environmental assessment studies, especially those dealing with sociological impact. Excellent contact has been established between the researchers and governmental agencies, hence results can reach users with little difficulty. Also, the state government plays an active role in project coordination and dissemination of findings. The overall research program involves five individual projects at two universities. The following are the project titles: (1) Projections of Montana Coal Mining and Energy Conversion Development, Project No. 278. (2) Vigil Network Establishment for the Region of the Proposed Eastern Montana Coal Development, Project No. 408. (3) Development of Resource Data on Lands Likely to be Affected by Human Population Changes Related to Mining and Power Generation Development in Southeastern Montana, Project No. 142. (4) Remote Sensing of Resource Data on Southeastern Montana Rangelands, Project No. 272. (5) Regionwide Evaluation of Available Hydrologic Data Water Resource Considerations for the Proposed Eastern Montana Coal Development, Project No. 397.

PUBLICATIONS: Final report to NSF-RANN.

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PROJECT TITLE: Development of Resource Data on Lands Likely to be Affected by Human Population Changes Related to Mining and Power Generation Development in Southeastern Montana

INVESTIGATOR/ORGANIZATION: Gene F. Payne, Animal and Range Science Department, Montana State University, Bozeman, MT 59715, (406) 994-3721

FUNDING AGENCIES: U.S. National Science Foundation, RANN; Montana Agricultural Experiment Station

FUNDING AMOUNT: NSF-RANN - \$42,700 (5/75 - 10/76); MAES - \$6,200

DURATION: 5/75 - 10/77

LOCATION: MT - Ashland area

DESCRIPTION: The objectives of this research are: (1) To establish as a base for future reference the status of ecosystems in southeastern Montana most likely to be influenced by the development of intensive and extensive urban development and recreational use; (2) To establish the characteristics of small watersheds in areas likely to be affected by the development of urban housing and recreational uses; (3) To establish classification and evaluation systems for major ecosystem components which can be used by county and state agencies in developing base data for planning and management.

COAL

1.4 CONVERSION

SYNTHETIC FUELS

MHD

OTHER

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PROJECT TITLE: An Analysis of the Applicability of the Production of Synthetic Liquid Fuels From Coal in Montana

INVESTIGATOR/ORGANIZATION: John McBride, Montana Energy and MHD Research and Development Institute, Box 3809, Butte, MT 59701, (406) 494-4569

FUNDING AGENCY: U.S. Federal Energy Administration (through the Montana Energy Advisory Council)

FUNDING AMOUNT: \$3,500

DURATION: 5/76 - 7/76 (Completed)

LOCATION: MT - Statewide

DESCRIPTION: This analysis included a description of the technology of coal liquefaction, economics of the technology and applicability of liquefaction in Montana. (NOTE: Part of the No. Tier Crude Oil Study, Project No. 432.)

PUBLICATIONS: John McBride. Coal Liquefaction: Technology, Impacts, and Technical Suitability for Montana. September 1976. Available from the Montana Energy Office, State Capitol, Helena, MT 59601.

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PROJECT TITLE: Analysis of Off-Site Lurgi Requirements

INVESTIGATOR/ORGANIZATION: Lummus Corporation, 1515 Broad St., Bloomfield, NJ

FUNDING AGENCY: Montana Trade Commission, Butte, Mt.

FUNDING AMOUNT: \$0

DURATION: 6/76 - 7/76 (Completed)

LOCATION: MT - Statewide

DESCRIPTION: Determination of off-site, non-Lurgi requirements necessary for the development of a Lurgi high btu gasification facility. Their work included manpower, capital cost, and resource requirements for non-Lurgi operating units. (NOTE: This study is part of the Montana Coal Gasification Task Force Study, Project No. 154.)

PUBLICATIONS: Analysis of Off-Site Lurgi Requirements. July 1976. The Lummus Co.

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PROJECT TITLE: Catalytic Hydrogenation of Coal-Derived Liquids

INVESTIGATORS/ORGANIZATION: Lloyd Berg, F.P. McCandless, Chemical Engineering Dept., Montana State Univ., Bozeman, MT 59715, (406) 994-2222

FUNDING AGENCY: U.S. Energy Research and Development Administration, Office of Coal Research

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FUNDING AMOUNT: \$155,932

DURATION: 6/75 - 6/78

LOCATION: MT

DESCRIPTION: It is the object of this research to convert coal to clean distillate fuels. This program will be limited to research on the product from existing coal liquefaction processes. Liquefied coal will be converted by catalytic hydrogenation at elevated temperatures and pressures. Samples of the product from PAMCO, H-Oil, COED and Cresap processes will be obtained. They will be heated and pumped, with and without solvent into a catalytic reactor in the presence of hydrogen and other reducing gases. Variables to be investigated will include temperature, pressure, space, velocity, hydrogen-to-oil molybdate and sulfide, cobalt molybdate and sulfide, nickel tungstate and other combinations on carriers such as mordenites and other molecular sieve types.

PUBLICATIONS: Quarterly reports to ERDA (FE-2034). Distribution Code UC-90D.

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PROJECT TITLE: Coal Hydrogenation

INVESTIGATOR/ORGANIZATION: Lloyd Berg, Chemical Engineering Dept., Montana State Univ., Bozeman, MT 59715, (406) 994-2222

FUNDING AGENCY: AVCO Everett Research Laboratory, Everett, MA

FUNDING AMOUNT: \$62,730

DURATION: 7/69 - 6/75 (Completed)

LOCATION: MT

DESCRIPTION: A study of the conversion of Colstrip sub-bituminous coal into liquid products using carbon monoxide and steam as the reducing agents.

PUBLICATIONS: S.T. Kujawa. Masters Thesis. Montana State Univ. August 1974. Also Dan Nguyen. Ph.D. Thesis. Montana State University. August 1973.

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PROJECT TITLE: Coal Hydrogenation and Hydrocracking Using a Metal Chloride Gaseous HCl Catalyst System

INVESTIGATOR/ORGANIZATION: F.P. McCandless, Dept. of Chemical Engineering, Montana State University, Bozeman, MT 59715, (406) 994-2221

FUNDING AGENCY: U.S. National Science Foundation

FUNDING AMOUNT: \$55,959

DURATION: 7/75 - 6/77 (Request has been made for an extension.)

LOCATION: MT

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DESCRIPTION: Initial research will be concerned with the design and testing of a continuous reactor which will utilize a high pressure star feeder for continuous powdered coal feed. Various reactor configurations (tubular, both large and small, fluid bed, etc.) will be considered and a reactor designed so that meaningful kinetic data can be obtained. Initial experiments will be carried out to find operating conditions so that the activity of different catalysts can be compared. This will be followed by an exhaustive screening of possible candidate catalysts using the above conditions as standard. Emphasis will be placed on metal chlorides but other materials (for example molybdate) impregnated on the coal will be tested in the HCl environment. The best catalysts will be further tested to try to enhance the activity using various promoters. This will be followed by further tests to determine the effects of temperature, pressure, amount of catalyst impregnated on the coal, space velocity, H₂ to HCl ratio, etc. on conversion and the amount of liquid and gaseous products so that the variables can be optimized. Kinetic models will be determined based on these data. Along with the kinetic studies, research will be carried out to completely characterize the liquid, gas, and unreacted coal products.

PUBLICATIONS: Progress reports to the U.S. National Science Foundation.

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PROJECT TITLE: Cost/Demand Analysis

INVESTIGATOR/ORGANIZATION: Don Brelsford, Mt. Energy and MHD Research and Development Institute, P.O. Box 3809, Butte, MT 59701, (406) 494-4569

FUNDING AGENCY: U.S. Federal Energy Administration (through the Montana Task Force on Coal Gasification)

FUNDING AMOUNT: \$20,000

DURATION: 6/76 - 11/76 (Completed)

LOCATION: MT - Statewide

DESCRIPTION: Preceding any determination of Montana gasification viability, the relationship between fuel production cost and marketability must be explored. This study will examine the relationships that exist between gas costs, supply and demand and will yield an estimate of the marketability of the products generated in a 1985 - 1995 time frame. (NOTE: This study was part of the Montana Coal Gasification Task Force, Project No. 154.)

PUBLICATIONS: Montana Natural Gas Demand Study. December 1976. Montana Energy and MHD Research and Development Institute.

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PROJECT TITLE: Environmental Effects from Leaching of Coal Conversion By-Products (ERDA No. E 49-(18)-2019)

INVESTIGATORS/ORGANIZATION: Ronald Erickson and Wayne Van Meter, Dept. of Chemistry, Univ. of Montana, Missoula, MT 59801, (406) 243-4022

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FUNDING AGENCY: U.S. Energy Research and Development Administration, Division of Fossil Fuels

FUNDING AMOUNT: \$74,798

DURATION: 6/75 - 6/78

LOCATION: MT, ND, WY

DESCRIPTION: The objective of this project is to conduct tests which will characterize the ash and slag materials with regard to the amounts of the more toxic chemical elements that will be released, and the rates at which that release occurs. Selection of elements we feel are likely to be leached in hazardous quantity from landfill ash dumps has been made from these tabulations under the following criteria: (a) the relative toxicity of the element; (b) the relative concentration of the element in the coal; and (3) the likelihood that the element will remain in the ash. The final objective of this proposal is simply to try to expedite the use of Ft. Union formation coal in one or more of the gasification or liquefaction pilot plants.

PUBLICATIONS: Quarterly progress reports to ERDA.

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PROJECT TITLE: Impacts of Synthetic Liquid Fuels Development

INVESTIGATORS/ORGANIZATION: Edward M. Dickson, Robert M. Rodden, Stanford Research Institute, Menlo Park, CA 94025

FUNDING AGENCY: U.S. Energy Research and Development Administration (primary); U.S. Environmental Protection Agency

FUNDING AMOUNT: \$280,000 - EPA

DURATION: 7/74 - 6/76 (Completed)

LOCATION: MT, WY, CO, ND, NM (Colorado River, Upper Missouri River Basin)

DESCRIPTION: This study assesses the impacts of the development of synthetic liquid fuels from coal and oil shale. The fuels considered are synthetic crude oils from coal and oil shale and methanol from coal. Key issues examined in detail are the technology and all of its resource requirements, net energy analyses of the technological options, a maximum credible implementation schedule, legal mechanisms for access to coal and oil shale resources, financing of a synthetic liquid fuels industry, decision making in the petroleum industry government incentive policies, local and national economic impacts, environmental effects of strip mining, urbanization of rural areas, air pollution control, water resources and their availability, and population growth and boom town effects in previously rural areas.

PUBLICATIONS: E.M. Dickson, et al. Impacts of Synthetic Liquid Fuel Development. Volumes I & II. EPA 600/7-76-004 A.B. ERDA 128-1 and 128-2.

151

PROJECT TITLE: In Situ Gasification of Deep Thick Western Coal Deposits
(ERDA No. W-7405-Eng-48)

INVESTIGATOR/ORGANIZATION: Douglas R. Stephens, Lawrence Livermore Laboratory, L-502, P.O. Box 808, Livermore, CA 94550, (415) 447-1100 x7991

FUNDING AGENCY: U.S. Energy Research and Development Administration

FUNDING: FY75 \$3.5M, FY76 \$3.5M, Interim quar. \$794K, FY77 \$2.7M

DURATION: 7/72 - 1983

LOCATION: MT, WY (deep site in the Powder River Basin of WY, and a shallow site at Hoe Creek, WY)

DESCRIPTION: The conversion of coal into a clean, combustible gas can permit environmentally sound utilization of our principal fossil resource. If the conversion to gas can be accomplished with the coal underground (in-situ coal gasification) then additional environmental and economic advantages can be realized. The objective of the Laboratory's deep in situ coal gasification program is to develop a commercial process for gasifying deep (150-1000m), thick western coals to produce pipeline quality gas. Oxygen and steam or carbon dioxide are introduced into the prepared coal bed, as in conventional high BTU gasification, and the produced gases are further treated at the surface to the desired end product. The process does not require mining or result in the production of surface wastes.

PUBLICATIONS: Numerous. Contact Investigator for publication list.

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PROJECT TITLE: Low-BTU Gasification of Coal for Montana Applications

INVESTIGATOR/ORGANIZATION: John McBride, Montana Energy and MHD Research and Development Institute, P.O. Box 3809, Butte, MT 59701, (406) 494-4569

FUNDING AGENCY: State of Montana (Montana Energy Advisory Council)

FUNDING AMOUNT: Approx. \$500.00 DURATION: 7/76 - 1/77 (Completed)

LOCATION: MT - Statewide

DESCRIPTION: The purpose of this project was to assemble an annotated bibliography of recent literature related to low-BTU gasification so that interested researchers might have easier access to the technology of low-BTU gasification.

PUBLICATIONS: John R. McBride. Low-BTU Gasification: An Annotated Bibliography of the Technology. January 1977. Available from The Montana Energy Office, Capitol Station, Helena, MT 59601.

153

PROJECT TITLE: Lurgi Process Evaluation

INVESTIGATOR/ORGANIZATION: John Gallagher, American Lurgi Corporation, 377 Rt. 17, Hasbrouck Heights, NJ 07604

FUNDING AGENCIES: Montana Trade Commission; Old West Regional Commission; U.S. Federal Energy Administration; U.S. Dept. of Commerce, Economic Development Admin., Electric Power Research Institute (through the Montana Task Force on Coal Gasification)

FUNDING AMOUNT: \$20,000

DURATION: 6/76 - 6/76 (Completed)

LOCATION: MT - Statewide

DESCRIPTION: The American Lurgi Corporation has been contracted to evaluate their process taking into account unique features and constraints for synthetic natural gas production in Montana. This study will provide the Task Force with both a conceptual design and preliminary engineering specifications for a 180 million cubic foot per day facility, utilizing Montana lignite. (NOTE: This study is part of the Montana Task Force on Coal Gasification, Project No. 154.)

PUBLICATIONS: Lurgi Process Evaluation. June 1976. American Lurgi Corporation. Available from the Montana Trade Comm., P.O. Box 767, Butte, MT 59701.

154

PROJECT TITLE: Montana Task Force on Coal Gasification

INVESTIGATOR/ORGANIZATION: James R. Hodge, Montana Trade Commission, P.O. Box 767, Butte, MT 59701, (406) 723-3228

FUNDING AGENCIES: Montana Trade Commission; Electric Power Research Institute; U.S. Dept. of Commerce, Economic Development Admin.; U.S. Federal Energy Admin.; Old West Regional Commission

FUNDING AMOUNT: \$303,146

DURATION: 6/75 - 12/76 (Completed)

DESCRIPTION: In June 1975, Governor Thomas Judge and the Montana Congressional Delegation established the Montana Task Force on Coal Gasification to investigate various methods of alleviating Montana's potential natural gas problem. The Task Force functioned as an investigative information gathering and evaluation source to determine the viability of coal gasification as a fuel resource for Montana. The results of activities engaged in by the Task Force will indicate to appropriate decision makers the potentials and problems associated with the production of synthetic gas and/or synthetic liquid fuels in Montana. The gasification feasibility program that the Task Force is currently pursuing divides the project into seven activity areas, six of which are listed separately under the following project titles: Technical Process Selection Study, Project No. 157; Lurgi Process Evaluation, Project No. 153; Analysis of Off-Site Lurgi Requirements, Project No. 144; Cost/Demand Analysis, Project No. 148; Site Trade-Off Study, Project No. 156.

PUBLICATIONS: Montana Coal Gasification Project - Feasibility Study, Final Report, December 1976. Prepared by the Montana Task Force on Coal Gasification.

155

PROJECT TITLE: Projecting Coal Gasification in the Northern Great Plains

INVESTIGATOR/ORGANIZATION: Richard L. Stroup, Agricultural Economics and Economics Dept., Montana State Univ., Bozeman, MT 59715, (406) 994-3701

FUNDING AGENCY: U.S. National Science Foundation, RANN

DURATION: 5/75 - 10/75 (Completed) LOCATION: MT - No. Great Plains

DESCRIPTION: Projects coal use by state for substitute natural gas and compares projections with those of other researchers.

PUBLICATIONS: (1) The Political Economy of Coal Gasification: Some Determinants of Demand for Western Coal. MSU Ag. Econ. Staff Paper 75-17. (2) Richard Stroup and Walter Thurman. Forecasting Coal Gasification Activity in the Northern Plains. October 1975. MSU Ag. Econ. Staff Paper 75-22.

156

PROJECT TITLE: Site Trade-Off Study

INVESTIGATOR/ORGANIZATION: Don Brelsford, Montana Energy and MHD Research and Development Institute, P.O. Box 3809, Butte, MT 59701. (406) 494-6100

FUNDING AGENCY: U.S. Federal Energy Administration (through the Mt. Task Force on Coal Gasification)

FUNDING AMOUNT: \$30,000 DURATION: 6/76 - 9/76 (Completed)

LOCATION: MT

DESCRIPTION: This study will examine the merits of siting at a mine mouth location versus a site currently possessing an infrastructure but located in an area remote to coal and water resources. A mine mouth site has the advantage of short haul distances which facilitate the transportation to the feedstock and in turn minimizes resource transportation cost. The remote site has housing, sewers, road systems and amenities and would, therefore, lessen the socio-economic problems arising from the development of an industrial facility which would require a relocation of work forces to that area. (NOTE: This study is part of the Montana Task Force on Coal Gasification, Project No. 154.)

PUBLICATIONS: Resource, Economics and Social Aspects of a Potential Coal Gasification Plant in Northeastern Montana. September 1976. Prepared by the Mt. Energy and MHD Research and Development Institute.

157

PROJECT TITLE: Technology Process Selection Study

INVESTIGATOR/ORGANIZATION: Dravo Corporation, One Oliver Plaza, Pittsburgh, PA 15222

FUNDING AGENCIES: Montana Trade Comm.; Electric Power Research Inst.; U.S.

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Synthetic Fuels

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Dept. of Commerce, Economic Development Admin.; U.S. Federal Energy Administration; Old West Regional Commission (through the Mt. Task Force on Coal Gasification).

FUNDING AMOUNT: \$48,646

DURATION: 5/76 - 10/76 (Completed)

LOCATION: MT

DESCRIPTION: Before consideration can be given to the selection of an appropriate coal conversion process, technology state of the art must be compared and contrasted with specific requirements and problems imposed by the Montana environment. The Task Force's final decision and recommendation will require extensive justification and documentation of the suitability of a first generation gasification process versus the financial incentives which second generation or demonstration scale high BTU gasification processes offer. Additionally, coal liquifaction and oil/gas processes will be reviewed so that the decisions reached by the Task Force reflect the most suitable technology available at this time to meet Montana requirements. (Subtask of Project No. 154.)

PUBLICATIONS: Process Selection Study: SNG from Coal. November 1976. Prepared by The Dravo Corporation.

COAL/Conversion

MHD

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PROJECT TITLE: Characterization of Coal for Open Cycle MHD Power Generation Systems (Task A)

INVESTIGATOR/ORGANIZATION: Frank E. Diebold, Mt. College of Mineral Science and Technology, Butte, MT 59701, (406) 792-8321 x270

FUNDING AGENCY: U.S. Energy Research and Development Administration (through the Mt. Energy and MHD Research and Development Institute, Inc.)

FUNDING AMOUNT: To date \$118,340; FY77 \$118,000

DURATION: 4/75 - 3/78

LOCATION: MT

DESCRIPTION: A study to characterize in detail McKay seam coal to assess its applicability to and performance in direct coal-fired MHD electrical generation systems. Emphasis is on method development for sample analyses coupled with development of a scheme for geochemical mapping. Coal properties to be determined are: (1) BTU, % moisture, volatile matter, fixed carbon ash, S, H, C, O, N, Cl and F content; (2) Major inorganic constituents of the coal ash, Al, Ca, Fe, K, Mg, Na, Si, Ti; (3) Trace elements of the coal ash, Ag, As, B, Ba, Be, Cd, Co, Cr, Cs, Cu, Ga, Hg, La, Li, Mn, Ni, P, Pb, Rb, Sb, Se, Sn, Sr, U, V, Sn, Sr, U, V. A secondary objective is a study of the potential environmental problems resulting because of the presence of inorganic elements in the coal.

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PUBLICATIONS: Progress reports to ERDA.

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PROJECT TITLE: Corrosion Studies of MHD Preheater Materials (Task B)

INVESTIGATORS/ORGANIZATION: William D. Callister, William C. Seymour, Montana College of Mineral Science and Technology, Butte, MT 59701, (406) 792-8321

FUNDING AGENCY: U.S. Energy Research and Development Admin. (through the Mt. Energy and MHD Research and Development Institute, Inc.)

FUNDING AMOUNT: To date \$132,687; FY77 \$128,030 DURATION: 4/75 - 3/78

LOCATION: MT

DESCRIPTION: A study to investigate the corrosion behavior of potential MHD preheater refractory materials under conditions of anticipated preheater conditions; i.e., at elevated temperatures to 1700 degrees C, while being exposed to slags and slags containing K_2O , and in both air and a controlled gaseous environment. Tests are to be conducted on high purity single crystals as well as dense polycrystals so as to ascertain the intrinsic corrosion behavior of the material. Commercially available refractory materials are also to be tested. Material characterization with respect to impurity concentration, microstructure, and porosity is to be carried out. During the current funding period an apparatus to measure the creep resistance of these materials as they are being corroded with slags and slag-seeds is to be constructed.

PUBLICATIONS: A report on this project will be published in the proceedings of The 16th Symposium on Engineering Aspects of Magnetohydrodynamics, and The Conference on High Temperature Sciences Related to Open-Cycle, Coal-Fired MHD Systems. Also progress reports to ERDA.

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PROJECT TITLE: Preparation of Coals for Utilization in Direct Coal-Fired MHD Generation (Task C)

INVESTIGATOR/ORGANIZATION: Gordon F. Ziesing, Dept. of Metallurgy and Mineral Processing, Mt. College of Mineral Sciences and Technology, Butte, MT 59701, (406) 792-8321

FUNDING AGENCY: U.S. Energy Research and Development Administration (through the Montana Energy and MHD Research and Development Institute, Inc.)

FUNDING AMOUNT: To date \$121,628; FY77 \$154,758 DURATION: 4/75 - 3/78

LOCATION: MT

DESCRIPTION: Rosebud seam coal from Colstrip and Sarpy Creek, MT is one of several regional coals that have been selected to fuel prototype MHD combustors. One of the properties of coal which adversely affects MHD generator performance

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is coal moisture. Water in fired coal extracts enthalpy from the combustion flame, which decreases plasma conductivity, and lowers generator power output and cycle efficiency. Parametric studies have indicated that Rosebud coal must be thermally dried below 5 percent moisture to be effectively used for MHD power generation. To examine the feasibility of drying Rosebud coal to low moisture levels, a series of in-house and vendor drying tests have been performed in bench and pilot-size drying equipment. Data collected from these studies are analyzed to show the dependency of the moisture content of Rosebud coal on such parameters as particle size, temperature, humidity and pore structure. Arrhenius plots of drying data are presented and shed light on the mechanism of moisture removal. The requirements for drying Rosebud coal to various moisture levels in thermal dryers is analyzed using a computer simulation in which heat and mass flow rates for drying are constrained by the experimentally determined relationship between coal moisture and dryer off-gas humidity. These results are compared to the requirements for demisting bituminous coal.

PUBLICATIONS: G.F. Ziesing. Preparation of Rosebud Coal for Utilization in Direct Coal Fired MHD Generation. December 1976. (ERDA No. 49-18-184, MEMRDI No. 75-001.)

161

PROJECT TITLE: Preliminary Design of a Direct Fired, Falling-Bed Air Preheater for an MHD Generator Test Facility (Task D)

INVESTIGATORS/ORGANIZATION: R.L. Mussulman, Dept. of Mechanical Engineering, Montana State Univ., Bozeman, MT 59715, (406) 994-2203; W.E. Genetti, Dept. of Chemical Engineering, MSU, Bozeman, MT 59715, (406) 994-2221

FUNDING AGENCY: U.S. Energy Research and Development Administration (through the Montana Energy and MHD Research and Development Institute, Inc.)

FUNDING AMOUNT: \$82,219 DURATION: 3/75 - 7/76 (Research inactive at present)

LOCATION: MT

DESCRIPTION: The contract shall undertake the preliminary design of the high temperature stage of a direct fired air preheater for use in an MHD generator test facility that is to be directly fired by various coals at a thermal level proposed by the contractor and approved by the contracting agency. The design shall be of a falling bed configuration that delivers preheated air at 3100 degrees F. Consideration shall be given to heat transfer, heat loss, pressure level, pressure losses, chamber geometries, valving, hopper required to transport particles from the upper to lower chamber, methods to distribute bed particles within chambers, particle sizes, particle velocities, particle recycling gas velocities, slag removal potential and materials. Emphasis will be on developing design and operating criteria, including preliminary layout drawings. From these, small scale experiments of the falling bed concept shall be defined. Parameters such as thermal effectiveness, pressure losses, coal types, materials problems, start up and shut down, and relative costs shall be examined.

PUBLICATIONS: Progress reports to ERDA.

162

PROJECT TITLE: Slag Flow and NO_x Kinetics: Moderate Temperature Slag Flow Facility (Task E)

INVESTIGATORS/ORGANIZATION: Harry W. Townes, Thomas C. Reihman, Mechanical Engineering Department, Montana State Univ., Bozeman, MT 59715, (406) 994-2203

FUNDING AGENCY: U.S. Energy Research and Development Administration (through the Montana Energy and MHD Research and Development Institute, Inc.)

FUNDING AMOUNT: To date \$321,537; FY77 \$300,642 DURATION: 3/75 - 3/78

LOCATION: MT

DESCRIPTION: The contractor shall design, procure and/or fabricate a laboratory, bench scale Moderate Temperature Slag Flow Facility (MTSFF) suitable for experimentally studying the behavior of slag flow under conditions simulating those anticipated in direct fired heat exchangers for MHD test facilities and plants. The initial test sections shall be directed toward the materials and circular flow geometries that approximate the flow channels of packed bed, high temperature stage regenerative MHD air preheaters. The facility shall use off-the-shelf hardware wherever possible and consist of the following major components: burner and associated fuel/seed/air system, entrance ducting, test heat exchanger channel, exhaust system and environmental protection devices, test section wall temperature and heat flux controls, and facility controls and instrumentation. The contractor shall conduct an analytical analysis of the slag flow problem. A major objective of this model is to predict slag deposition rates on MHD heat exchanger surfaces. The contractor shall conduct a literature survey and a critical evaluation of existing computer programs concerning NO_x concentrations in MHD power plants.

PUBLICATIONS: T.C. Reihman, H.W. Townes, and C.J. Mozer. Thermal Analysis Techniques for Regenerative Heat Exchanger Simulation (presented at the 1976 ASME Winter Annual Meeting, ASME Paper 76-WA/HT-7). Also, C.K. Sande, H.W. Townes, and T.C. Reihman. Particulate Deposition in Direct Fired MHD Air Preheaters (Accepted for presentation at the 1977 Nat'l. Heat Transfer Conf., Salt Lake City, ASME Paper 77-HT-65.)

163

PROJECT TITLE: Slag Seed Equilibria and Separation Related to the MHD System (Task F)

INVESTIGATOR/ORGANIZATION: Ray Woodruff, Dept. of Chemistry, Montana State Univ., Bozeman, MT 59715, (406) 994-4111

FUNDING AGENCY: U.S. Energy Research and Development Administration (through the Montana Energy and MHD Research and Development Institute, Inc.)

FUNDING AMOUNT: To date \$212,345; FY77 \$131,197 DURATION: 3/75 - 3/78

LOCATION: MT

DESCRIPTION: The contractor shall obtain the vapor pressure of potassium seed and seed compounds and other species over liquid coal slags. An existing

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constant temperature furnace shall be modified as required for this purpose, and instrumentation capable of accurate measurement of the vapor pressure of various elements and compounds above slag at temperatures up to 2200 degrees F shall be developed. The vapor pressure of K_2O and other species as feasible over at least two coal slags shall be measured over a range of temperatures. A computer program(s) shall be developed for the calculation of vapor pressure of potassium and potassium compounds over a range of slag composition and temperatures.

PUBLICATIONS: Numerous. Contact the Office of MHD and Energy Research at Montana State University for publication list.

164

PROJECT TITLE: Slag Physical Properties: Properties of Current Carriers (Task G1)

INVESTIGATOR/ORGANIZATION: V. Hugo Schmidt, Dept. of Physics, Montana State Univ., Bozeman, MT 59715, (406) 994-3614

FUNDING AGENCY: U.S. Energy Research and Development Administration (through the Montana Energy and MHD Research and Development Institute, Inc.)

FUNDING AMOUNT: To date \$91,187; FY77 \$48,808 DURATION: 3/75 - 3/78

LOCATION: MT

DESCRIPTION: The contractor shall design, initiate construction and instrumentation of laboratory, bench scale apparatus for determining the following physical properties of coal slag-seed mixtures: electrical conductivity, thermal conductivity, viscosity, and concentrations and mobility of the current carriers. The apparatus shall be capable of operating isothermally over a range of temperatures up to 2200°C and to compatible with a variety of natural and synthetic slagseed mixtures. The contractor shall conduct initial experiments as feasible to demonstrate performance and accuracy. Comparisons with existing data appearing in the literature and known to be valid shall be performed.

PUBLICATIONS: (1) Progress reports to ERDA; (2) W. Beezhold, D. Blacketter, V.H. Schmidt, A. Kumnick and R. Pollina. Electricity from Coal Via Magnetohydrodynamics (MHD): Materials and Development Requirements (Presented at the 7th National SAMPE Technical Conference, October 1975.)

165

PROJECT TITLE: Physical Properties of Coal Slags: Thermionic Emission (Task G2)

INVESTIGATORS/ORGANIZATION: G. Lapeyre, J. Anderson, W. Anderson, Physics Dept., Montana State Univ., Bozeman, MT 59715, (406) 994-3614

FUNDING AGENCY: U.S. Energy Research and Development Administration (through the Montana Energy and MHD Research and Development Institute, Inc.)

FUNDING AMOUNT: To date \$74,431; FY77 \$70,140 DURATION: 3/75 - 3/78

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LOCATION: MT

DESCRIPTION: The contractor shall design, initiate construction and instrumentation of laboratory, bench scale apparatus for determining the physical property of coal slag-seed mixtures in relation to the thermionic work function. The apparatus shall be capable of operating isothermally over a range of temperature up to 2200°C and to be compatible with a variety of natural and synthetic slag-seed mixtures. The contractor shall conduct initial experiments as feasible to demonstrate performance and accuracy. Comparisons with existing data appearing in the literature and known to be valid shall be performed.

PUBLICATIONS: (1) Progress reports to ERDA; (2) J. Anderson, G.J. Lapeyre, R.J. Smith, and M. Wilson. Some Thermionic Emission Properties of Synthetic Coal Slag (Presented at Conference of High Temperature Sciences Related to Open-Cycle Coal-Fired MHD Systems, Argonne, IL, April 1977).

166
PROJECT TITLE: Slag Physical Properties: Electrical and Thermal Conductivity (Task G3)

INVESTIGATOR/ORGANIZATION: Richard J. Pollina, Physics Dept., Montana State Univ., Bozeman, MT 59715, (406) 994-3614

FUNDING AGENCY: U.S. Energy Research and Development Administration (through the Montana Energy and MHD Research and Development Institute, Inc.)

FUNDING AMOUNT: FY77 \$84,712 .

DURATION: 3/75 - 10/76 (Part of Task G1); 10/76 - 3/78(Task G3)

LOCATION: MT

DESCRIPTION: The presence of coal slag in MHD channels and perhaps in heat exchangers is an unavoidable, and in some ways desirable, aspect of coal-fired MHD power generation. Proper design of such MHD systems must take the mechanical, electrical, and chemical properties of slag into account. Coal slag can have a great variety of properties, which depend upon coal composition, amount and type of seed and other additives, combustor and channel conditions, temperature, and interaction with vapor components in the plasma stream. This task is directed toward determination of three types of kinetic or transport properties of coal slag under isothermal conditions: (1) electrical conductivity; (2) thermal conductivity; (3) viscosity. Emphasis in this program will be on slag from Montana coal with various seed concentrations. Initial measurements are planned for temperatures up to 1800° C because many problems are associated with the eventual goal of making measurements at 2200° C. Both the electrical conductivity and viscosity experimental systems are based on methods which the National Bureau of Standards has found to be successful with coal slag.

PUBLICATIONS: (1) Progress reports to ERDA; (2) R. Pollina and R. Larson. Electrical Conductivity of a Montana Coal Ash. (Presented at MHD Basic Science Conference at Argonne National Laboratory, April 1977.)

167

PROJECT TITLE: MHD Systems Instrumentation and Data Aquisition (Task H1)

INVESTIGATORS/ORGANIZATION: Roy M. Johnson and T. Robles, Electrical Engineering Dept., Montana State Univ., Bozeman, MT 59715, (406) 994-4271

FUNDING AGENCY: U.S. Energy Research and Development Administration (through the Montana Energy and MHD Research and Development Institute, Inc.)

FUNDING AMOUNT: To date \$155,872; FY77 \$42,311 DURATION: 3/75 - 3/78

LOCATION: MT

DESCRIPTION: The contractor shall conduct a study of a completely integrated direct coal fired base load MHD steam plant having a thermal input of 4000 MW. The study is to include the determination of the desired location, quantity, data base requirements, preliminary interface requirements and software structure for the instrumentation and control of such a facility. Consideration shall also be given to environmental, economic and social aspects in the location, siting, effluent control and waste of such a plant.

PUBLICATIONS: Progress reports to ERDA. Numerous other publications. Contact the Office of MHD and Energy Research, Montana State Univ. for publication list.

168

PROJECT TITLE: MHD Systems, Instrumentation and Control (Inverter) (Task H2)

INVESTIGATOR/ORGANIZATION: R. Durnford, Dept. of Electrical Engineering, Montana State Univ., Bozeman, MT 59715, (406) 994-4491

FUNDING AGENCY: U.S. Energy Research and Development Administration (through the Montana Energy and MHD Research and Development Institute, Inc.)

FUNDING AMOUNT: \$42,342

DURATION: 3/75 - 7/76 (Project inactive at present - may be continued at a later date.

LOCATION: MT

DESCRIPTION: The contractor shall conduct a study of DC to AC inverter configurations suitable for use with commercial MHD generators. Consideration shall be given to inverters for three types of channels: (1) two-terminal diagonal, (2) multi-terminal diagonal, (3) segmented faraday. The advantages and disadvantages of the individual voltage-current quantities developed by each of these channel designs shall be evaluated and the control of these relationships together with the type and desirable number of individual inverters determined. The inverter control is to be examined along with necessary circuitry required to realize an inverter system interfacing with an MHD generator and a power grid system. Emphasis shall be placed on identifying suitable commercial devices.

PUBLICATIONS: Progress reports to ERDA.

169

PROJECT TITLE: MHD Cycle Analysis and Control (Task H3)

INVESTIGATOR/ORGANIZATION: Donald A. Pierre, Electrical Engineering Department, Montana State Univ., Bozeman, MT 59715, (406) 994-2282

FUNDING AGENCY: U.S. Energy Research and Development Administration (through the Montana Energy and MHD Research and Development Institute, Inc.)

FUNDING AMOUNT: To date \$100,721; FY77 62,442 DURATION: 3/75 - 3/78

LOCATION: MT

DESCRIPTION: The contractor shall conduct a study to determine MHD instrumentation and data acquisition requirements for current and planned test facilities to accurately establish operating conditions and to provide maximum data availability for any failure mechanisms. The emphasis is to be placed on real-time data analysis and control. Consideration shall be given to instrumentation type, locations, acquisition rate and data handling.

PUBLICATIONS: Numerous. Contact the Office of MHD and Energy Research, Montana State Univ. for publications list.

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PROJECT TITLE: MHD Systems, Instrumentation and Control (Recovery and Utilization of Dilute Nitric Oxide from an MHD Generator) (Task H4)

INVESTIGATOR/ORGANIZATION: F. McCandless, Dept. of Chemical Engineering, Montana State Univ., Bozeman, MT 59715, (406) 994-4491

FUNDING AGENCY: U.S. Energy Research and Development Administration (through the Montana Energy and MHD Research and Development Institute, Inc.)

FUNDING AMOUNT: \$41,417

DURATION: 3/75 - 8/76 (This research is inactive at present -- may be continued at a later date.)

LOCATION: MT

DESCRIPTION: The contractor shall conduct a study of the benefits from and potential processes for the production of nitric acid and/or a fixed nitrogen fertilizer from the dilute nitric oxide containing gas stream of an MHD power plant. The study will include identification of areas critical to the recovery and utilization of the dilute NO_x and identify appropriate laboratory experiments.

PUBLICATIONS: Progress reports to ERDA.

171

PROJECT TITLE: MHD Environmental Impact Study (Task H5)

INVESTIGATOR/ORGANIZATION: Don Breilsford, Montana Energy and MHD Research and Development Institute, P.O. Box 3809, Butte, MT 59701, (406) 494-4569

FUNDING AGENCY: U.S. Energy Research and Development Administration

DURATION: 3/75 - 7/76 (Continuation of H5 is under Task M.) LOCATION: MT

DESCRIPTION: The power plant siting study of this task has completed the first phase. Investigation of the potential environmental impact aspect of the MHD power generation process continues. Investigation of sources for related and applicable computer programs for environmental impact modeling of MHD power generation is continuing. Chemical and physical property data of western coals has been gathered for review. Technical literature analysis of recovering spent seed and sulfur from the exhaust gases of a MHD power plant is underway. A literature review of methods for developing multipliers necessary to estimate the indirect and secondary economic effects of an MHD steam power generating facility was done. An aerial inspection and photographic survey was carried out on the major coal fired, electric generating plants, operating and under construction in Wyoming and Montana. The particular characteristics of the individual power plant site plan and its relationship to the coal source and cooling water supply was also studied.

PUBLICATIONS: Progress reports to ERDA.

172

PROJECT TITLE: ETF Environmental Engineering and Evaluation (Task M)

INVESTIGATOR/ORGANIZATION: Susan Brown, The Montana Energy and MHD Research and Development Institute, P.O. Box 3809, Butte, MT 59701, (406) 494-4569

FUNDING AGENCY: U.S. Energy Research and Development Administration

DURATION: 6/76 - 9/78 LOCATION: MT

DESCRIPTION: The Engineering Test Facility (ETF) siting study has completed the first two phases. Analysis of candidate site areas will proceed during the forthcoming year. The objective of the ETF Environmental Engineering and Evaluation is to identify a potentially suitable site for a large, western-based, coal-fired MHD steam power plant. The work is aimed at determining a potential location based upon appropriate environmental, social, and economic aspects related to construction and operation of the MHD steam power plant facility. (NOTE: Task M continues the work begun under Task H5.)

PUBLICATIONS: Progress reports to ERDA.

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PROJECT TITLE: Socioeconomic Impact of the MHD-CDIF (Part of Task M)

INVESTIGATORS/ORGANIZATION: Karen Barclay, Tom Pelletier, Gary Fischer, Montana

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Energy and MHD Research and Development Institute, P.O. Box 3809, Butte, MT 59701, (406) 494-4569

FUNDING AGENCY: U.S. Energy Research and Development Administration

DURATION: 6/77 - Continuing

LOCATION: MT - Silver Bow Co. (Butte)

DESCRIPTION: The Component Development and Integration Facility (CDIF), a 50 MW coal-fired, open cycle MHD facility currently is under construction in the Industrial Park at Butte, Montana. In studying the environmental effects of the CDIF, a major concern is the social and economic impact on the community of Butte. The objective of the socio-economic study is to identify and monitor the impacts of the CDIF construction and operation on the Butte area. In this part of the study, we provide the necessary baseline data of the CDIF specifications to carry out that objective. (NOTE: Task M continues the work begun under Task H5.)

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PROJECT TITLE: CDIF Environmental and Evaluation Program (Task Q)

INVESTIGATOR/ORGANIZATION: Edward Kukay, Montana Energy and MHD Research and Development Institute, P.O. Box 3809, Butte, MT 59701, (406) 494-4569

FUNDING AGENCY: U.S. Energy Research and Development Administration

DURATION: 9/76 - continuing

LOCATION: MT - Silver Bow Co. (Butte)

DESCRIPTION: The Monitoring and Evaluation under Task Q will ensure that the operation of the MHD-CDIF will adhere to existing federal and state environmental regulations. Verification of the MHD-CDIF environmental impacts will be accomplished by statistical comparisons between baseline (pre-operational) and future (operational) environmental parameters. The objective of this program is to establish a minimal environmental surveillance network and to accurately monitor and evaluate the environmental impacts of the MHD-CDIF facility at Butte, Montana. Studies will be related to air quality and water quality parameters; meteorological and climatological conditions; and botanical characteristics of the South Butte District.

PUBLICATIONS: Progress reports to ERDA.

175

PROJECT TITLE: Surface Analytical Studies of Micron and Sub-Micron Fly Ash from Coal-Fired MHD

INVESTIGATOR/ORGANIZATION: Peter L. Gobby, Physics Dept., Montana State Univ., Bozeman, MT 59717, (406) 994-3614

FUNDING AGENCY: U.S. Environmental Protection Agency (through the Montana Energy and MHD Research and Development Institute)

FUNDING AMOUNT: \$4,633

DURATION: 8/77 - 9/78

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MHD

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LOCATION: MT

DESCRIPTION: Coal-fired power plants are known to emit fly ash particles from hundreds of microns to less than one micron in size. Studies have indicated that the smaller particles have a greater concentration of trace elements (both toxic and non-toxic), and that the majority of these trace elements occur at the surface of the particles. Coal-fired MHD power plants may complicate the situation even further. Preliminary studies indicate that, due to the higher combustion temperatures and the quenching of exhaust gases, a much larger fraction of the particulate fly ash is in the sub-micron range. The potential problems here are significant. First the sub-micron fly ash will be much more difficult to contain or filter out the particles on the order of 100 microns. Second the previous studies would imply that trace element concentrations would be even higher. It is the objective of this proposal to use relatively new, state of the art, surface analytical techniques to determine the chemical and physical micro-structure of these sub-micron particles. If the kinetics of formation of these particles can indeed be understood, the information could be vital to design engineers wishing to avoid and/or contain the sub-micron particulate matter resulting from a coal-fired MHD plant.

176

PROJECT TITLE: Fly Ash Analysis Using the MSU Ion Beam/Van de Graaff Analysis Laboratory

INVESTIGATOR/ORGANIZATION: Wendland Beezhold, MHD Energy Research, Montana State Univ., Bozeman, MT 59715, (406) 994-4491

FUNDING AGENCY: Battelle Northwest Laboratories, Richland, WA

FUNDING AMOUNT: \$5,000

DURATION: 11/76 - 1/77 (Completed)

LOCATION: MT

DESCRIPTION: Depth profiles for the elements Ti, Zn, Ni, Pb, Cr, Cu, Hg, and V are to be obtained in four fly ash samples, each having a different fly ash particle size distribution. The techniques to be used include Proton-Induced X-ray (PIX) and Rutherford Backscattering (RBS) analysis.

COAL/Conversion

Other

177

PROJECT TITLE: Direct Burning of Coal by Montana Industry

INVESTIGATOR/ORGANIZATION: John McBride, Montana Energy and MHD Research and Development Institute, P.O. Box 3809, Butte, MT 59701, (406) 494-4569

FUNDING AGENCY: State of Montana (through the Montana Energy Advisory Council)

177 CONT.

FUNDING AMOUNT: Approx. \$300.00

DURATION: 7/76 - 1/77 (Completed)

LOCATION: MT - Statewide

DESCRIPTION: With the impending shortage of natural gas, the option of replacing gas with coal must be examined. This is particularly the case with industrial gas use in Montana.

PUBLICATIONS: John R. McBride. Direct Coal Combustion, Montana Energy Conservation Plan, Working Paper No. 11. January 1977. Available from the Montana Energy Office.

178

PROJECT TITLE: Direct Conversion of Lignite to Chemical Feedstocks Via a Combination of Molten Salt Catalysis and Solvent Refining Technologies

INVESTIGATOR/ORGANIZATION: Warren P. Scarrah, Dept. of Chemical Engineering, Montana State Univ., Bozeman, MT 59717, (406) 994-2221

FUNDING AGENCY: U.S. Energy Research and Development Administration

FUNDING AMOUNT: \$19,900

DURATION: 11/77 - 10/78

LOCATION: MT

DESCRIPTION: The objectives of this program are: (1) To determine the potential for directly converting lignite to chemical feedstocks via a process combining technologies from molten salt catalysis and solvent refining; (2) To investigate the effects of alkali metal halides added to zinc chloride catalyst on product distribution and hydrocarbons-salt separation; (3) To determine the effects on product distribution of hydrogen sources as influenced by reducing gas composition, lignite moisture, and added water; and (4) To identify the significant processing variables (alkali metal halides and hydrogen sources) preparatory to more comprehensive process studies. A fractional experimental design will be used with the alkali metals lithium, sodium, and potassium to evaluate halides (chloride, bromide, iodide), reducing gases (hydrogen, carbon monoxide, syngas), and water sources (wet lignite, dry lignite, dry lignite plus added water). Batch runs using a rocking autoclave will be appropriate for undergraduate student operation due to their simplicity and shortness. Product analyses by gas chromatography and nuclear magnetic resonance will be made by experienced technicians.

179

PROJECT TITLE: Fuel Cell Development Study

INVESTIGATOR/ORGANIZATION: J.J. Rasmussen, Montana Energy and MHD Research and Development Institute, P.O. Box 3809, Butte, MT 59701, (406) 494-4569

FUNDING AGENCY: U.S. Energy Research and Development Administration

FUNDING AMOUNT: \$246,934

DURATION: 6/77 - 9/78

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LOCATION: MT

DESCRIPTION: The current ERDA goal for an electrical utility fuel cell operating directly or indirectly on coal appear to be served best by high temperature fuel cell technology -- either the molten carbonate electrolyte system, or the solid electrolyte system. These systems have the best potential for the electro-oxidation of coal and coal-derived secondary fuels because of their ability to provide high temperature activation of fuels with attendant simplified electrocatalytic problems. MERDI has begun work in a program directed at finding materials for fuel cell alternatives to overcome the material problems associated with high temperature fuel cells. The work consists of two separate tasks: (1) Development of materials with microstructural properties suitable for the containment of molten carbonate electrolytes for the 40,000 hour or longer lifetime of a fuel cell operating in the temperature range of 450-900°C; (2) Evaluation of the properties of construction materials and solid electrolyte materials developed for electrodes in the MHD program and determination of methods to modify these materials.

180

PROJECT TITLE: Heat Transfer from Horizontal Finned Tube Bundles in a Fluidized Bed

INVESTIGATOR/ORGANIZATION: William Genetti, Dept. of Chemical Engineering, Montana State Univ., Bozeman, MT 59715, (406) 994-2222

FUNDING AGENCY: U.S. National Science Foundation, Division of Engineering

FUNDING AMOUNT: \$67,100

DURATION: 9/73 - 12/79

LOCATION: MT

DESCRIPTION: In carrying out the physical, chemical process in a fluidized bed, a need to transfer energy to or from a heat transfer surface often occurs. Consequently, the quantitative heat transfer data between the surface and the bed is needed for the rational design of heat transfer to tube bundle for a fluidized bed operation. Several experimental studies of horizontal extended surface tube bundles in a fluidized bed have been performed. No data has been reported for vertical extended tube bundle in a fluidized bed. Since cylindrical vessels are easier to construct and since it has been difficult to place horizontal tube bundles in a cylindrical vessel, an experimental study of vertical tube bundles is needed. The primary objective of the present research is to experimentally determine and correlate heat transfer from vertical extended surface tube bundles in a fluidized bed. Variables to be considered will include fin height, fin thickness, fin spacing, fin material, fin type, particulate diameter, tube spacing and gas mass velocity. Heat conduction within the extended surface will be analyzed theoretically. The major features of the experimental apparatus will include: a one foot diameter cylindrical fluidized bed, electric carriage heaters, air blower, and measuring devices. The extended surface tubes to be studied include helical fin tubes, segmented fin tubes, spiral tubes, and spined tubes.

PUBLICATIONS: (1) W.E. Genetti, et al. (Houston Meeting, AI Ch.E. 1977); (2) W.E. Genetti, et al (A.I. Ch.E. Symp. Series - to be published in 1977); (3) W.E. Genetti, et al (A.I. Ch.E. Symp Series 128, 69 -- 1973); (4) W.E. Genetti, et al (A.I. Ch.E. Symp. Series, 116, 90 - 1971).

COAL

1.5 EXTRACTION

COAL/Extraction

181

PROJECT TITLE: Design and Evaluation of Improved Surface Coal Mine Overburden Handling and Coal Extraction Techniques (J0255023)

INVESTIGATOR/ORGANIZATION: John A. Bowersmith, Theodore Barry and Associates, 1151 West Sixth Street, Los Angeles, CA 90017, (213) 481-7371

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Mines, Spokane Mining Research Center

FUNDING AMOUNT: \$148,000

DURATION: 7/75 - 6/76 (Completed)

LOCATION: Rocky Mountain, Northern Great Plains, and Interior Coal Provinces

DESCRIPTION: Four innovative surface mining methods are developed which promise high quality reclamation while maintaining production of low-cost coal. The terrace-pit system excavates overburden with mobile equipment and transports and deposits the spoils with either scrapers or trucks. The pit is bowl shaped and terraced at both ends. Rehandling is not required because spoil placement is easily controlled, and reclamation grading can be concurrent with production. The area haulback system excavates overburden with a dragline, deposits the spoil on the highwall, then hauls it back into the pit with trucks. This system can substantially increase coal production in deep pits, is competitive with draglines when spoil rehandling reaches 50 percent, and provides for selective spoil placement. In periphery mining, the dragline excavates overburden along a curved pit which first circumscribes an area and continues in a spiral fashion to mine toward the center of the property. This results in reduced handling, concurrent reclamation, the elimination of spoil haulage roads, and an averaged stripping ratio. The twin tower excavator system excavates unconsolidated overburden with a bucket dragged by cables running between two towers stationed on each side of the pit. The towers leave no spoil ridges typical of dragline operations. Operating costs are about the same as dozers and front-end loaders.

PUBLICATIONS: John A. Bowersmith, et. al. Design and Evaluation of Improved Surface Coal Mine Overburden Handling and Coal Extraction Techniques. June 1976. U.S. Bureau of Mines. (NTIS, 5285 Port Royal Road, Springfield, VA 22161, No. PB-264 764/AS, \$6.75.)

182

PROJECT TITLE: Limits and Cost Sensitivity of Alternate Parting Handling Methods

INVESTIGATOR/ORGANIZATION: Thomas E. Finch, Montana College of Mineral Sciences and Technology, Butte, MT 59701, (406) 792-8321

FUNDING AGENCY: Primary -- U.S. Department of the Interior, Bureau of Mines; Secondary - State of Montana (Montana Tech)

FUNDING AMOUNT: \$41,410 (BOM); \$2,000 (Montana Tech)

DURATION: 12/75 - 4/77 (Completed)

LOCATION: Western U.S.

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DESCRIPTION: Objective - Generate a computer program to look at cost sensitivity of different methods of parting handling. Physical limits of applicable machinery will also be considered.

PUBLICATIONS: Final report to the Bureau of Mines, April 1977.

183

PROJECT TITLE: Methods and Costs of Thin Seam Mining (BOM No. G0274010)

INVESTIGATOR/ORGANIZATION: Thomas E. Finch, Montana College of Mineral Sciences and Technology, Butte, MT 59701, (406) 792-8321

FUNDING AGENCY: Primary - U.S. Department of the Interior, Bureau of Mines;
Secondary - State of Montana (Montana Tech)

FUNDING AMOUNT: \$51,186 (BOM); \$4,318 (Montana Tech)

DURATION: 9/77 - 9/78

LOCATION: Western U.S. coal provinces

DESCRIPTION: This project proposes to examine a particular piece of the surface mining whole. At this point in time it is particularly appropriate to examine the practice and cost of removing stray seams associated with the thick coal seams found in the western U.S.

184

PROJECT TITLE: Optimal Dragline Operating Techniques (BOM No. H0272003)

INVESTIGATOR/ORGANIZATION: Tom Boyce, Fluor-Utah, Inc., 177 Bouet Road, San Mateo, CA 94402, (415) 574-1111

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Mines, Spokane Mining Research Center, Spokane, WA

FUNDING AMOUNT: FY 77 \$230,000

DURATION: 6/77 - 3/78

DESCRIPTION: Develop optimal dragline operating techniques to increase coal production by a minimum of 2 to 5 percent in single seam mining. Current operating techniques along with specific time analysis will be bathered. Improved technology will be developed. Developed techniques will be compared against current practices, both theoretically and operationally, through a field demonstration.

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PROJECT TITLE: Research Study of Design and Development of Area Terrace Pit Mining Systems

INVESTIGATOR/ORGANIZATION: Contact, Gregory G. Miller, Project Officer, Spokane Mining Research Center, U.S. Bureau of Mines, E. 315 Montgomery Avenue, Spokane, WA 99207, (509) 484-1610

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FUNDING AGENCY: U.S. Department of the Interior, Bureau of Mines, Spokane Mining Research Center, Spokane, WA

FUNDING AMOUNT: FY 77 \$180,000

DURATION: 9/77 - 5/79

LOCATION: Rocky Mountans, No. Great Plains, and Interior Coal Provinces

DESCRIPTION: The primary problem associated with a dragline surface mining system is that the combination of a meandering highwall, deep overburden, and undulating terrain may necessitate costly and unproductive rehandling of spoil material. The terrace-pit concept permits total, direct placement of overburden materials, thereby eliminating the spoil rehandling problems associated with a dragline operation. The equipment utilized by a terrace-pit system consists essentially of mobile units for overburden removal, spoil handling, and coal extraction and haulage. Because this type of equipment is readily available, a new mine can be brought into production in a relatively short period of time as compared to the long lead times required for the delivery and construction of a dragline. The terrace-or benched-pit system is amenable to flat, gently rolling or sloping topography, pitching seams, and irregularly-shaped permit areas. In addition, selective overburden placement is easily integrated into the system. The terrace and spoil benches can be designed to alleviate highwall and spoil instability problems and minimum dozer time is required for spoil leveling. Further examination of the terrace-pit concept under varying operating conditions and equipment combinations is warranted to establish its economic and physical limitations and practicality.

COAL

1.6 GEOLOGY AND SOILS

COAL/Geology and Soils

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PROJECT TITLE: Coal Geology of the Northern Powder River Basin, Wyoming and Montana

INVESTIGATORS/ORGANIZATION: W.J. Mapel, W.C. Culbertson, E.J. McKay, B.H. Kent, U.S. Geological Survey, Geologic Division, Box 25046, Denver Federal Center, Denver, CO 80225, (303) 234-3578

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Geologic Division

DURATION: 7/74 - Continuing LOCATION: MT, WY (No. Powder River Basin)

DESCRIPTION: The Powder River Basin of Wyoming and Montana contains much of the minable low-sulfur coal resources of the United States. This project will provide detailed coal resource and stratigraphic information in selected areas in which little modern information is available and which are vital to our understanding of the tertiary coal-bearing rocks and of the magnitude and make-up of the total coal resources of the area.

PUBLICATIONS: Numerous field study maps and other publications. Contact investigator for publication list.

187

PROJECT TITLE: Coal Petrology Study

INVESTIGATOR/ORGANIZATION: Michael Woods, Mt. Department of State Lands, Helena, MT 59601, (406) 449-2074

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Conservation Division (through its joint mineral evaluation program with the Montana Bureau of Mines)

FUNDING AMOUNT: Approx. \$5,000

DURATION: 2/77 - 12/77 (Complete)

LOCATION: Coal regions of central and eastern Montana

DESCRIPTION: Considerable variation in inorganic content may be expected within a single coal basin correlating with lateral position and maceral content. Such variations would correspond not only with total ash, but also with trace elements such as F, B, Mn, Ba and Sr, all of which occur in very high local concentrations with Northern Powder River Basin coals and which are of possible environmental significance. One purpose of the study is to examine, by petrographic microscope, a thorough sampling of coals from central and eastern Montana in an effort to establish a rapid means of evaluating large coal measures for ash and trace element contents. This will involve some electron microprobe work. A second goal is to obtain reflectance measurements in the bentonite macerals within the coal. Such reflectance should correlate with BTU content, and is a possible means of rapidly evaluating the economic potential of coal measures. The work will complement the efforts of Frank Diebold at Montana Tech who is working under a grant from the Montana Energy and MHD Research and Development Institute.

COAL/Geology and Soils

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PROJECT TITLE: Coal Resources of Pearl School Quadrangle and Adjoining Areas, Big Horn County, Montana

INVESTIGATOR/ORGANIZATION: G.L. Galyardt, U.S. Geological Survey, Conservation Division, Box 25046, Denver Federal Center, Denver, CO 80225

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Conservation Division

DURATION: 7/75 - Fall 1978

LOCATION: MT - Big Horn County

DESCRIPTION: Objective - To submit the compiled map and associated coal sections for technical review. Field work is essentially done. Compilation work is in progress.

PUBLICATIONS: A geologic map, cross section, and coal sections will be published as an open-file report or MF series report in the Fall of 1978.

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PROJECT TITLE: Energy Lands Program -- Engineering Geologic Studies, Powder River Basin (9550-01631)

INVESTIGATOR/ORGANIZATION: F.W. Osterwald, U.S. Geological Survey, Engineering Geology Branch, Mail Stop 903, Box 25046, Denver Federal Center, Denver, CO 80225

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Geologic Division

DURATION: 7/75 - 9/79

LOCATION: MT, WY (Powder River Basin)

DESCRIPTION: Activities - Continue investigations of landslides and associated slope stability processes. Continue study of surface subsidence over abandoned underground coal mines and in areas of burning coal beds. Study stability of cut slopes in strip mines. Continue engineering geologic mapping at Sheridan, Wyoming, and regional engineering geologic mapping of the northwestern part of the Powder River Basin. Seismic monitoring of strip mines and proposed mine sites. Engineering geophysical investigations in support of geologic mapping and associated geotechnical studies. Geotechnical analyses of drill cores from selected sites.

PUBLICATIONS: M.P. Fahy, and W.K. Smith. 1976. Geotechnical Properties of Some Upper Fort Union Rocks from the Decker Area, Big Horn County, Montana. U.S. Geological Survey Open-File Report 76-596.

F.W. Osterwald, Compiler. 1976. Engineering Geologic Characteristics, Part B of Summary of the Geology, Mineral Resources, and Engineering Geologic Characteristics of the No. Powder River Coal Region, Montana, U.S.G.S. Admin. Report.

190

PROJECT TITLE: Evaluation of Lignite Reserves, Girard Field, Montana (9055-75)

INVESTIGATOR/ORGANIZATION: Mary Alice Spencer, U.S. Geological Survey, Conservation Division, P.O. Box 2550, Billings, MT 59103, (406) 657-6185

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Conservation Division

DURATION: 7/75 - 1978

LOCATION: MT - Richland and Roosevelt Counties

DESCRIPTION: Open-file report, a known recoverable coal resource area, and two quadrangle maps are being prepared. All are now in the final stages of preparation or initial review stage. More drilling will continue in 1977 and 1978 to enable us to correlate with coal fields adjacent to the Girard Field.

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PROJECT TITLE: Evaluation of Lignite Resources, Sidney Coal Field, Montana

INVESTIGATOR/ORGANIZATION: Gary L. Berg, U.S. Geological Survey, Conservation Division, P.O. Box 2550, Billings, MT 59103, (406) 657-6185

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Conservation Division

DURATION: 7/75 - 6/78

LOCATION: MT - Richland, Dawson, and Wibaux Co., ND

DESCRIPTION: Objectives of the field mapping project include completion of the Sidney NE Quadrangle, Montana-North Dakota and possible completion of the Piche Quadrangle, Montana. Scale 1:24,000. Objectives for overall coal evaluation in the Sidney KRCRA include 10,000 feet of proposed drill hole. From this data, the appropriate maps will be drawn.

PUBLICATIONS: Sidney KRCRA (Known Recoverable Coal Resource Area). Available from the Conservation Manager, Central Region, USGS, Mail Stop 609, Box 25046, Denver Federal Center, Denver, CO 80225.

192

PROJECT TITLE: Field Sampling of Future Strip Mine Areas, Fort Union Region, Montana

INVESTIGATOR/ORGANIZATION: Robert E. Matson, Energy Division, Montana Bureau of Mines and Geology, Butte, MT 59701, (406) 792-8321

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Branch of Mineral Classification

FUNDING AMOUNT: \$10,479

DURATION: 3/76 - 7/78

LOCATION: MT - Fort Union Region

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DESCRIPTION: Channel samples for trace-element studies will be collected from operating mines in Montana and Wyoming. A thorough sampling project at the Decker Coal Mine has been completed and samples submitted to the USGS for detailed chemical analysis. Future plans include undertaking a detailed sampling project of Westmoreland Resources Sarpy Creek Mine.

PUBLICATIONS: Open-File reports listing analytical results of collected coal samples.

193

PROJECT TITLE: Fort Union Coal Characteristics

INVESTIGATOR/ORGANIZATION: Robert E. Matson, Energy Division, Mt. Bureau of Mines and Geology, Butte, MT 59701, (406) 792-8321

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Bureau of Mineral Classification

FUNDING AMOUNT: \$605,000 (FY77 - \$100,000) DURATION: 11/76 - 5/78

LOCATION: Fort Union Region of eastern Montana and northeastern Wyoming

DESCRIPTION: The primary objectives of this project are to collect, evaluate, characterize and integrate new data on the economically important coal beds of the Fort Union Region of eastern Montana and northeastern Wyoming. The new data will assist in evaluation of Federal lands to meet the new requirements under the Coal Leasing Amendments Act of 1975, and it will assist in solving correlation problems and provide data on economically recoverable coal. This project is integrated with ongoing surface mapping being carried out by USGS geologists.

194

PROJECT TITLE: Geochemical Survey of the Western Coal Regions

INVESTIGATOR/ORGANIZATION: Jon J. Connor, U.S. Geological Survey, Branch of Regional Geochemistry, Denver Federal Center, Denver, CO 80225, (303) 234-3715

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey

DURATION: 7/74 - 6/79 LOCATION: MT, WY, ND

DESCRIPTION: The objective of the program is to make a reconnaissance geochemical survey of the area of the coal-bearing rocks in the Rocky Mountains and No. Great Plains. The survey will emphasize the geochemistry of the rocks (rather than the coal), the soils and vegetation that overlie these rocks, and the water contained in the rocks and in streams draining substantial parts of the areas underlain by the rocks. The survey will attempt to provide geochemical background summaries against which future changes in the geochemical environment in or adjacent to developed areas, including Colstrip, Montana, may be realistically measured.

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PUBLICATIONS: Geochemical Survey of the Western Energy Regions, 1st Annual Progress Report, 1974: USGS Open-File Report 74-250; 2nd Annual Progress Report, 1975: USGS Open-File Report 75-436; 3rd Annual Progress Report, July 1976: USGS Open-File Report 76-729; 4th Annual Progress Report, July 1977: USGS Open-File Report 77-872.

195

PROJECT TITLE: Geologic Factors for Mapping Reclamation Potential of Western Coal Lands (0930-01560)

INVESTIGATOR/ORGANIZATION: H.E. Malde, U.S. Geological Survey, Mail Stop 913, Box 25046, Denver Federal Center, Denver, CO 80225

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Geologic Division

DURATION: 7/74 - 6/75 (No activity in Mt. in 1977 and 1978.)

LOCATION: MT, ND, SD, WY, AZ, CO, NM, UT

DESCRIPTION: Decisions on surface mining of western coal call for knowledge of the feasibility of reclamation, but the reclamation potential is poorly understood. This project deals with a range of geologic factors of terrain and water that directly influence the degree to which reclamation can be achieved. Mining for strippable coal, for example: (1) causes the mined land to be raised or lowered in elevation, depending on the ratio of overburden to thickness of coal; (2) obliterates, or modifies, large and small irregularities of the original terrain; (3) interferes with surface water by changing stream gradients, sediment load, dissolved solids, flood discharge, channel shape, and channel position; and (4) changes conditions of ground water by removing aquifers, lowering the water table, reducing storage and rate of flow, increasing dissolved solids, and modifying areas of recharge. Because these circumstances of terrain and water place limits on reclamation achievements, this study is directed toward a fuller determination of reclamation potential based on measurement of such pertinent geologic, hydrologic, and geomorphic factors as variety and steepness of slope, diversity of landscape, conditions of erosion, density and character of surface drainage, nature of resistant outcrops, variations in soils and overburden, and structure of the coal deposits with respect to topography and water supply.

PUBLICATIONS: H. E. Malde and J. M. Boyles. 1976. Maps of Alluvial Valley Floors and Strippable Coal in Forty-two 7½-minute quadrangles, Big Horn, Rosebud, and Powder River Counties, Southeast Montana: USGS Open-File Report 76-162.

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PROJECT TITLE: Holmes Ranch Quadrangle (9056-75)

INVESTIGATORS/ORGANIZATION: N.E. Micklich, J. Waring, U.S. Geological Survey, Conservation Division, P.O. Box 2373, Casper, WY 82601

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Conservation Division

COAL/Geology and Soils

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DURATION: 7/75 - 6/76 (mapping completed)

LOCATION: MT

DESCRIPTION: Objectives - Evaluate coal deposits, establish or revise known coal leasing areas, and acquire coal resource data needed for coal resource occurrence maps and coal resource development potential. Provide coal resource data to establish minimum acceptable bonus bids, calculate advance royalties, and outline prospective lease blocks and logical mining units. Provide geologic data for probable site specific environmental analysis or impact statements. Accumulate data concerning coal deposits to support BLM's coal leasing program and to provide basic data for identification and updating of leasable mineral resource potential of federal lands for retention, disposal, and multiple use classification. (1:250,000 leasable mineral and waterpower classification maps.)

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PROJECT TITLE: McCone County, Montana, Lignite Resource Evaluation (9053-75)

INVESTIGATOR/ORGANIZATION: Herbert B. Wincentzen, U.S. Geological Survey, Conservation Division, P.O. Box 2550, Billings, MT 59103, (406) 657-6185

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Conservation Division

DURATION: 7/75 - 6/78

LOCATION: MT - McCone County

DESCRIPTION: Evaluate coal deposits, establish or revise known coal leasing areas, and acquire coal resources data needed for coal resource occurrence maps and coal resource development potential maps. Provide coal resource data to establish minimum acceptable bonus bids, calculate advance royalties, and outline prospective lease blocks and logical mapping units. Provide geologic data for probable site specific environmental analyses or impact statements. Accumulate data concerning coal deposits to support BLM's coal leasing program and to provide basic data identification and updating of leasable mineral use classification. (1:250,000 leasable mineral and waterpower classification maps.)

PUBLICATIONS: Preliminary Study of Lignite Resources, McCone County. Open-file report currently in editing process within USGS. Circle KRCRA is prepared and is being reviewed. No date for availability can be given at this time.

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PROJECT TITLE: Rates of Erosion in the Colstrip Area

ORGANIZATION: Mt. Dept. of State Lands, Helena, MT 59601, (406) 449-2074

FUNDING AGENCY: State of Montana (Mt. Department of State Lands)

DURATION: 6/75 - Continuing

LOCATION: MT - Rosebud County (Colstrip)

DESCRIPTION: The Montana Dept. of State Lands presently discourages the establishment of permanent impoundments in reclaimed areas. Settling ponds are

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dismantled after disturbance in an area has ceased. Study of erosion rates and sources of sediment would help the Department establish a more soundly based timetable of settling pond destruction. The initial studies provide field data to help answer the following questions: (1) Rates of sheet erosion on divide and interstream areas; (2) Rates of slope retreat adjacent to steep walled gullies. The most significant erosive processes at work in areas studied in the arid west are those which cannot be visually evaluated. A doubling of the rate of sheet wash erosion on reclaimed slopes, not visually detectable, would produce a great increase in sediment load to receiving streams.

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PROJECT TITLE: Research on Geologic Analysis of Selected Coal Model Areas

INVESTIGATOR/ORGANIZATION: E.R. Landis, U.S. Geological Survey, Office of Energy Resources, Branch of Coal Resources, Box 25046, Denver Federal Center, Denver, CO 80225

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Geologic Division

DURATION: 7/74 - 6/75 (Project no longer active in Montana.)

LOCATION: MT, WY, UT

DESCRIPTION: The project objectives are research into (1) The acquisition and evaluation of the geologically significant information about areas that are geologic models of potential sites for the coal mines that will provide the energy for the coal refinery and power plant operations of the future; and (2) The best manner and form in which to present the resulting information so as to be of maximum benefit to the largest number of potential users. Resource studies involve primarily cost but include as integral parts of the program investigation of water resources and resources of commodities that are associated with coal-bearing sequences, such as clays, or that result from processes, such as metalliferous ash. An important part of the program will be the development of detailed information useful for evaluating the social, environmental, and economic costs of increased coal use in the U.S.

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PROJECT TITLE: Soils Analyses in the Poplar Basin

INVESTIGATOR/ORGANIZATION: Abe Horpestad, Water Quality Bureau, Mt. Dept. of Health and Environmental Sciences, Helena, MT 59601, (406) 449-2406

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$1,800

DURATION: 1/77 - 12/77

LOCATION: MT - Poplar River Basin

COAL/Geology and Soils

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DESCRIPTION: Developments proposed by the Saskatchewan Power Corporation in the Poplar River area of Canada may have harmful impacts on the soils of Montana. Such impacts may be derived from air- and/or water-borne contaminants emanating from the power project. The goal of this effort is to establish baseline conditions upon which the adverse effects on extant soils in Montana resulting from reduced quality of irrigation waters and also high levels of gases and particulates emanating from the power plant may be evaluated. At least 15 sites will be sampled with three samples being taken from representative spots at each site. Records will be kept on profile descriptions, topography, surface slope, soil series, years of cultivation, years of irrigation, source of water, crop data, management practices, disturbances, microrelief, complete description of site location, and a location sketch for each sample. (This study is a sub-project of EPA's Poplar River Study, Project No. 129.)

PUBLICATIONS: A final report will be submitted to EPA at conclusion of study.

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PROJECT TITLE: Spring Gulch Quadrangle (9063-75)

INVESTIGATOR/ORGANIZATION: Nancy E. Micklich, U.S. Geological Survey, Conservation Division, P.O. Box 2373, Casper, WY 82601

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Conservation Division

DURATION: 7/75 - continuing

LOCATION: MT

DESCRIPTION: Evaluate coal deposits, establish or revise known coal leasing areas, and acquire coal resource data needed for coal resource occurrence maps and coal resource development potential. Provide coal resource data to establish minimum acceptable bonus bids, calculate advance royalties, and outline prospective lease blocks and logical mining units. Provide geologic data for probable site specific environmental analysis or impact statements. Accumulate data concerning coal deposits to support BLM's coal leasing program and to provide basic data and identification and updating of leasable mineral resource potential and federal lands for retention - disposal and multiple use classification. (1:250,000 leasable mineral and waterpower classification maps.)

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PROJECT TITLE: Tertiary History - Middle Rocky Mountains (9440-00174)

INVESTIGATOR/ORGANIZATION: N.M. Denson, U.S. Geological Survey, Geologic Division, P.O. Box 25046, Denver Federal Center, Denver, CO 80225

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Geologic Division

DURATION: 7/74 - 6/75

LOCATION: MT (Powder River Basin), WY, CO, NE

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DESCRIPTION: Objectives - 1) To assemble and systematically compile information of the thicknesses, lithology, structure, paleontology, mineralogy, and geochemistry of tertiary sedimentary rocks within the middle Rocky Mountains and Northern Great Plains and to reconstruct insofar as possible the geologic history of the region during this period with particular reference to structural development. 2) To appraise the usefulness of mineralogic and chemical characteristics to supplement paleontologic data in stratigraphic correlation of these rocks. Activities - Study of tertiary sedimentary rocks relating to uraniferous sandstone deposits and coal in the Powder River Basin of Eastern Wyoming and Southeastern Montana.

203

PROJECT TITLE: Trace Element Analyses of Colstrip Coal

INVESTIGATOR/ORGANIZATION: Robert A. Chadwick, Department of Earth Sciences, Montana State Univ., Bozeman, MT 59715

FUNDING AGENCY: Montana Power Company, Butte, MT

FUNDING AMOUNT: \$8,500

DURATION: 4/73 - 4/75 (Completed)

LOCATION: MT - Rosebud County (Colstrip)

DESCRIPTION: Concentrations of sulfur and trace elements in the Rosebud and McKay coal seams from Western Energy Company controlled properties in the Colstrip field have been determined and their distribution plotted. Trace elements were analyzed by furnace atomic absorption spectroscopy (except for fluorine). Elements run were: antimony, arsenic, boron, beryllium, cadmium, chromium, copper, fluorine, germanium, lead, manganese, mercury, nickel, selenium, and zinc. Trace elements were determined from air dried, pulverized coal samples representing cores from 49 drill holes penetrating the Rosebud seam and 26 in the McKay. In several holes, vertical increments of 5 feet were run separately. Sulfur data were taken from analyses by outside laboratories. The elements antimony, arsenic, beryllium, cadmium, mercury, nickel, selenium, and sulfur are markedly enriched in the basal foot or few feet of the coal seams, and in some places at the top. These enrichments appear related to visible concentrations of pyrite in these portions of the seams. Lateral variations of trace elements are less notable than vertical variations. The study contributes to an evaluation of possible air pollution hazards when mine-site power plants begin operation.

PUBLICATIONS: (1) Chadwick, R.A., et. al., 1975. Sulfur and Trace Elements in the Rosebud and McKay Coal Seams, Colstrip Field, Montana. Montana Geological Soc. Energy Resources of Montana, 22nd Ann. Publ. (2) Chadwick, R.A., et al., 1975. Lateral and Vertical Variations in Sulfur and Trace Elements in Coal -- Colstrip Field, Montana. Montana Acad. Sci., Proc. Ft. Union Coal Symposium, Vol. 3, p. 362-370.

204

PROJECT TITLE: Trace Element Analysis in Soils

INVESTIGATOR/ORGANIZATION: Ray Woodriff, Chemistry Dept., Montana State Univ., Bozeman, MT 59715, (406) 994-4111

FUNDING AGENCY: U.S. Environmental Protection Agency

COAL/Geology and Soils

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FUNDING AMOUNT: \$19,329

DURATION: 9/75 - 6/77

LOCATION: MT, WY, ND

DESCRIPTION: In order to furnish maximum information for the evaluation of the probable impact of strip mining on the study area, it is important to have the chemical composition of the strata to be disturbed, and the availability of both nutrients and harmful elements in this material. This research group at Montana State Univ. has been studying a system of separating soil solutions from the soil without appreciably changing the concentrations of the various elements in the soil solutions. This technique consists of centrifuging the natural soil or potential soil with carbon tetrachloride or other inert emulsifiable dense liquids. The water, being lighter than the support liquid, is driven to the top by centrifugal force, leaving the carbon tetrachloride between the water and the soil. The water is pipetted into a small graphite cup, evaporated, and the cup inserted into a constant temperature graphite tube furnace. The absorption of the vapor produced is measured with a spectrometer. Work has started on the application of this technique to the problems that will be involved in evaluating the impact of strip mining in the area. This work will be carried out in cooperation with people working on other methods of extracting significant elements from soil or potential soil materials. The results of this study should not only provide the basis for evaluating the potential impact of strip mining on the study area, but should also provide the investigators of future areas of future areas with better and more precise evaluation techniques. (NOTE: This study is part of an overall project entitled A Cooperative Program to Evaluate Surface and Ground Water Problems Associated with Potential Strip Mine Sites, Project No. 357.)

PUBLICATIONS: (1) Immiscible Displacement of the Soil Solution by Centrifugation; (2) An Improved Technique for Measuring Soil pH; (3) An Improved Technique for Measuring In Situ Salinity of Soils.

205

PROJECT TITLE: Field Evaluation of Low-Sulfur Subbituminous Coal Reserves in the Fort Union Region of Montana and Wyoming

INVESTIGATOR/ORGANIZATION: Robert E. Matson, Energy Division, Montana Bureau of Mines and Geology, Butte, MT 59701, (406) 792-8321

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Conservation Division, Branch of Mineral Classification

FUNDING AMOUNT: \$219,446

DURATION: 11/75 - 11/76 (Completed)

LOCATION: MT, WY (Fort Union coal region)

DESCRIPTION: The primary objectives of this project were to collect new data on the economically important coal seams in the Fort Union Coal Region of Montana and Wyoming. In 1975-76, approximately 225 holes were drilled, and about 400 feet of coal cored. Increased emphasis will be placed on interpretation of the data acquired from the drilling and coring.

PUBLICATIONS: Open file reports of drill logs, lithologic logs, and core analyses.

COAL

1.7 LAND

RECLAMATION
MAPPING AND LAND USE

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PROJECT TITLE: Agricultural Use of Waste Gypsum from Sulfur (SO₂) Scrubbing Operation

INVESTIGATOR/ORGANIZATION: J.B. Skaptason, Biosearch and Development Co., Inc., 12700 Prospect Ave, Route 30, Kansas City, MO 84146

FUNDING AGENCY: Old West Regional Commission

FUNDING AMOUNT: \$233,379

DURATION: 4/75 - 3/79

LOCATION: MT, WY, ND, MO

DESCRIPTION: Objectives - The results obtained from this study will provide guidelines for determining the potential of waste gypsum from sulfur (SO₂) scrubbing operations as an agricultural soil amendment in the reclamation of sodic soils. The following are the main areas to be addressed for meeting the overall objective stated above: (1) Survey of pertinent literature, research, and industry (SO₂) scrubber methods; (2) Physical collection of gypsum waste, sodic soils, and spoil pile samples; (3) Chemical analysis of waste gypsum, alkali soils and spoils materials, before and after amendment treatment; (4) Greenhouse plant growth trials to evaluate selected amendments; (5) Field trials of promising greenhouse treatments. Emphasis for extension period on field testing.

PUBLICATIONS: J.B. Skaptason and J.A. Skaptason. Amendment Properties of Ammonium Sulfate and Ammonium Nitrate and Their Combinations With Gypsum and SO₂ Scrubber Waste. May 1977. Bio-Search and Development Co., Inc.

207

PROJECT TITLE: Bear Creek Reclamation Study Site Near Ashland, Montana

INVESTIGATORS/ORGANIZATIONS: Jack Chugg, U.S. Department of the Interior, Bureau of Land Management, Bldg. 50, Denver Fed. Center, Lakewood, CO 80225, (303) 234-2333; Herb Dupree, U.S. Dept. of the Interior, Bureau of Reclamation, P.O. Box 2553, Billings, MT, (406) 585-6518

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Land Management, Energy Minerals Rehabilitation Inventory and Analysis (EMRIA) Program; USGS

FUNDING AMOUNT: Approx.\$157,500

DURATION: 7/75 - 4/77 (Completed)

LOCATION: MT - Rosebud County (near Ashland)

DESCRIPTION: Objective - To conduct reconnaissance studies on the 3,200-acre Bear Creek EMRIA Study Site near Ashland, Montana to provide data for evaluating the reclamation potential of that area after prospective surface mining for coal. A map showing annual source-area sediment yields has been prepared and the relationship of sediment yield to percentage bare soil and average watershed slope will be described for use in surrounding areas having similar climate and watershed characteristics. Estimates were made of the amount of sediment contributed from the study site area to Bear Creek. A map of the vegetation-soil units on the site was prepared from aerial photographs and

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on-site measurements. Vegetation, mulch, rock cover, and percentage of bare soil were measured in each unit. Internal water stress in the woody plants present was also measured. Small plots of vegetation were clipped to determine the yield of the various species. Soils were sampled in each vegetation-soil unit to determine the water-retention and erodibility characteristics and suitability of the soils for use in rehabilitation.

PUBLICATIONS: EMRIA report available from BLM Office, 316 N. 26th St., Billings, MT 59101

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PROJECT TITLE: Characterize Mine Spoil Microflora and Fauna of Blackbird, Decker, Ballard, and Leviathan Mines - Develop Techniques for Establishment of Microbiota in Sterile Mine Spoils

INVESTIGATORS/ORGANIZATIONS: Darwin Sorensen, Utah State Univ., Logan, UT; B.Z. Richardson, Paul E. Packer, USDA Forest Service, Intermountain Forest and Range Experiment Station, 860 N. 12th East, Logan, UT 84321

FUNDING AGENCIES: Primary - U.S. Department of Agriculture, Forest Service, Surface Environment and Mining (SEAM), and Intermountain Forest and Range Experiment Station (IF&RES). Secondary - U.S. Environmental Protection Agency

FUNDING AMOUNT: FY77 \$11,000 SEAM, \$7,000 IF&RES, \$5,500 EPA

DURATION: 7/74 - Continuing

LOCATION: MT - Big Horn County (Decker), ID, CA, UT, CO

DESCRIPTION: Problem - Revegetation of mine spoils is often difficult or impossible because mine spoils often lack beneficial microflora due to their extraction from sterile, deep earth zones and their toxicity and nutrient imbalance. Objectives - To determine the requirements for microbial establishment in selected acid, saline, and neutral mine spoils. Approach - Identify and produce microbial populations into unamended mine spoils. Laboratory research will be directed toward developing a microbial bioassay that can be used in evaluating mine spoil amendments that stimulate or support microbial development.

PUBLICATIONS: Contact SEAM, U.S. Forest Service, 145 Grand Ave., Billings, MT 59102 for information on publications.

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PROJECT TITLE: Characterization of Physical and Chemical Properties of Spoils

INVESTIGATORS/ORGANIZATION: F.M. Sandoval, R.E. Ries, J.F. Power, Northern Great Plains Research Center, U.S. Agricultural Research Service, P.O. Box 459, Mandan, ND 58554, (701) 663-6448

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining (SEAM)

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FUNDING AMOUNT: FY77 Approx. \$10,000

DURATION: 5/74 - Indefinite

LOCATION: Northern Great Plains

DESCRIPTION: Problem - Knowledge of the nature of and variability in the nature of properties of overburden materials in the Northern Great Plains is extremely limited and restricts reclamation. Objectives - To characterize those physical and chemical properties of overburden materials that have major effects upon reclamation, both in respect to areal distribution and depth.

210

PROJECT TITLE: Conceptual Design and Development of a Dry Land Sodding Reclamation System (BOM No. H0262043)

INVESTIGATOR/ORGANIZATION: Fred A. Leonard, Dames and Moore, 605 Parfet St., Lakewood, CO 80215

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Mines, Denver Mining Research Center

FUNDING AMOUNT: \$246,763 DURATION: 9/76 - 5/77 (Project cancelled)

LOCATION: MT, ND, WY, CO, UT, NM, AZ, SD (No. Great Plains and Rocky Mountain Coal Provinces)

DESCRIPTION: Objectives - (1) To develop conceptual designs for a dry land sodding reclamation system and subject these to feasibility analysis; (2) To design and fabricate modifications to existing equipment and conduct a field demonstration. Viable native seed sources are often not available and fickle climatic conditions often prevent rapid reclamation within a short time. Dames and Moore has been contracted to develop a dry land sodding reclamation system which should include removing an intact block of soil with its attendant vegetation from an area to be mined and placing the intact sod on regraded spoil.

PUBLICATIONS: A Phase I report will be issued.

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PROJECT TITLE: Dam Creek Reclamation Site-Overburden Investigation

INVESTIGATORS/ORGANIZATIONS: H.P. Dupree, U.S. Department of the Interior, Bureau of Reclamation, P.O. Box 2553, Billings, MT 59103; Fred Waldhaus, U.S. Dept. of the Interior, Bureau of Land Management, P.O. Box 30157, Billings, MT 59107, (406) 657-6474

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Land Management, Energy Minerals Rehabilitation Inventory and Analysis (EMRIA) Program

FUNDING AMOUNT: \$9,900

DURATION: 4/76 - 5/77 (Completed)

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LOCATION: MT - Powder River County

DESCRIPTION: Objective - To collect baseline conditions on vegetation, soil, overburden, coal resource, substrata below the coal and other environmental factors. These data prelease stipulations can be formulation. A soils inventory will be accomplished. Subsurface data will be determined from core samples.

PUBLICATIONS: Final report available from the U.S. Bureau of Land Management, 316 N. 26th St., Billings, MT 59101.

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PROJECT TITLE: Demonstration of Revegetation Techniques

INVESTIGATORS/ORGANIZATIONS: Frank Kenney, Decker Coal Company, c/o Peter Kiewit & Sons, Sheridan, WY 82801; Bland Z. Richardson, U.S. Forest Service, Intermountain Forest and Range Experiment Station, 860 No. 12th East, Logan, UT 84321

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining (SEAM), and Intermountain Forest and Range Experiment Station (IF&RES)

FUNDING AMOUNT: FY77 \$5,000 SEAM, \$5,000 IF&RES DURATION: 1/74 - Continuing

LOCATION: MT - Big Horn County (Decker Mine)

DESCRIPTION: Problem - The Decker Coal Company has a substantial area of new mine spoils. The State of Montana prescribes standards for rehabilitating such spoils. The IF&RES has research plots that have now provided some alternative rehabilitation treatments to test and demonstrate on a larger scale of several acres. Objectives - To plan and install a developmental application demonstration on the Decker Coal Mine of rehabilitation methods developed on research areas at the Decker Mine. Methods and Analyses - Comparisons of several alternative revegetation methods by actual demonstration on large areas.

PUBLICATIONS: Contact SEAM, U.S. Forest Service, 145 Grand Ave., Billings, MT 59102 for information on publications.

213

PROJECT TITLE: Design of Stable Channels to Remove Surface Runoff from Graded Mine Spoils

INVESTIGATORS/ORGANIZATIONS: Edward Burroughs, Jr., William Hartsog, USDA Forest Service, Intermountain Forest and Range Experiment Station, Forestry Sciences Laboratory, P.O. Box 1376, Bozeman, MT 59715; Eric Sundberg, Dept. of Animal and Range Sciences, Montana State Univ., Bozeman, MT 59715

FUNDING AGENCY: U.S. Environmental Protection Agency, Cincinnati National Research Center, Cincinnati, OH

FUNDING AMOUNT: \$47,000

DURATION: 10/77 - 6/79

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LOCATION: Western Coal Region

DESCRIPTION: The general objective is to develop guidelines for the design and construction of stable drainage channels for removal of surface runoff from graded spoils. The main emphasis will be on designs for surface mines in the planning stage. Another objective will be to develop techniques for construction of stable drainage channels on eroded lands that were reclaimed prior to the Montana reclamation law.

214

PROJECT TITLE: Determination of Optimum Topsoil Depth Requirements for Surface Coal-Mined Areas Within the Northern Great Plains Coal Province: Reclamation (BOM J0265025)

INVESTIGATOR/ORGANIZATION: Richard C. Barth, Colorado School of Mines Research Institute, P.O. Box 112, Golden, CO 80401, (303) 279-2581

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Mines, Denver Mining Research Center

FUNDING AMOUNT: \$152,090 (FY77 \$40,000) DURATION: 6/76 - 11/78

LOCATION: MT, WY, ND (Northern Great Plains)

DESCRIPTION: Topsoil is an important, and often essential, ingredient in the reclamation of strip mine spoils. Topsoil has chemical, physical, and biological properties ideally suited to support plant growth, and because of this, most states require the application of topsoil to regraded spoil surfaces. However, little is known about how much topsoil is needed for optimum plant growth on reclaimed areas. The Colorado School of Mines Research Institute is in the process of determining the amount of topsoil required to reclaim strip mine spoils in the Northern Great Plains. To accomplish this, 13 plots have been constructed at coal mines in the Northern Great Plains. The plots are designed to allow the depth of topsoil to vary from 0 to 5 feet. Plots were seeded in the Spring of 1977. Plant response will be evaluated annually starting in the fall of 1977.

PUBLICATIONS: R.C. Barth. Reclamation Practices in the Northern Great Plains Coal Province., In Mining Congress Journal, May 1977, P. 60-64. Also, R.C. Barth and M.K. Harthill. Use of Topsoil and Spoils as a Medium for Plant Growth. Available late Spring 1978.

215

PROJECT TITLE: Determine Physical, Chemical and Biological Properties of Spoil Materials Resulting from Coal Surface Mining That Inhibit Plant Growth

INVESTIGATORS/ORGANIZATION: Bland Z. Richardson, Paul E. Packer, N. Frisknecht, USDA Forest Service, Intermountain Forest and Range Experiment Station, 860 N. 12th East, Logan, UT 84321, (801) 752-1311

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FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining (SEAM) Program, and the Intermountain Forest and Range Experiment Station (IF&RES)

FUNDING AMOUNT: FY 77 \$1,000 SEAM, \$1,000 IF&RES DURATION: 10/72 - 12/78

LOCATION: MT, UT

DESCRIPTION: Problem: Spoil materials from western coal mining are generally saline. Some are sufficiently saline to be toxic, both from a pH standpoint and from standpoint of greater solubility of some metal elements, such as selenium and boron. Objectives - To determine the physical, chemical, and biological effect on plant growth of highly saline coal surface-mine spoils. Approach - (1) Bioassay of spoils with saline-tolerant plants in greenhouse; (2) Field trials of saline-tolerant plants on spoils; and (3) Treatment of spoils with amendments.

PUBLICATIONS: Contact SEAM, U.S. Forest Service, 145 Grand Ave., Billings, MT 59102 for information on publications.

216

PROJECT TITLE: Determining Natural Recurrence of Soil Decomposer Populations in Reclaimed Mine Areas (OWRC 10670257; FWS 14-16-0008-1252)

INVESTIGATOR/ORGANIZATION: J.B. Skaptason, Bio-Search and Development Co., Inc., 12700 Prospect, Kansas City, MO 64146

FUNDING AGENCIES: Old West Regional Commission; U.S. Department of the Interior, Fish and Wildlife Service

FUNDING AMOUNT: OWRC \$40,000; FWS \$40,000 DURATION: 9/76 - 8/78

LOCATION: MT, WY, ND

DESCRIPTION: There are many factors important to the reestablishment of vegetation cover on mining-disturbed lands. The status of soil decomposer population (saprophagous arthropods, bacteria, fungi, and algae) could significantly contribute to the success or failure of revegetation on disturbed lands, but a minimal amount of research has been completed thus far on their status. This study will investigate the natural recurrence of microbial populations on mining disturbed lands and compare these populations to microbial populations on adjacent undisturbed sites. If there is evidence that the populations on disturbed sites and undisturbed sites are significantly different in physiological or functional groups present and their abundance, additional research may be designed to investigate inoculation or other culture techniques for increasing microbial populations and activities on mining disturbed sites.

217

PROJECT TITLE: Develop Automatic Irrigation Systems for Grasses, Shrubs and Trees

INVESTIGATOR/ORGANIZATION: Bland Z. Richardson, Paul E. Packer, USDA Forest Service, Intermountain Forest and Range Experiment Station, 860 N. 12th East, Logan, UT 84321, (801) 752-1311

FUNDING AGENCY: U.S. Department of the Interior, Forest Service, Surface Environment and Mining (SEAM) Program, and the Intermountain Forest and Range Experiment Station (IF&RES)

FUNDING AMOUNT: FY77 \$1,000

DURATION: 6/73 - Continuing

LOCATION: MT - Big Horn County (Decker), UT (Sand Wash)

DESCRIPTION: Problem - Supplemental irrigation of vegetation of rehabilitated surface mine spoils requires frequent applications of water to keep the surface spoil layers moist while seedlings are trying to put roots down in semi-arid and arid areas. Especially during the hottest part of the growing season. Applications of water every few hours may be necessary. Accordingly, automated on-off irrigation systems are desirable to circumvent the need for someone to monitor the site continuously. Objectives - To design suitable overhead sprinkler system for use on research and demonstration sites to be irrigated. Approach - Acquire needed control systems (timers, valves, etc), assemble and test, install in field.

PUBLICATIONS: Contact SEAM, USDA Forest Service, 145 Grand Ave., Billings, MT 59102 for information on publications.

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PROJECT TITLE: Develop Criteria for Utilization of Irrigation to Ameliorate Adverse Site Conditions for Initial Plant Cover Establishment

INVESTIGATORS/ORGANIZATION: Bland Z. Richardson, Paul E. Packer, USDA Forest Service, Intermountain Forest and Range Experiment Station, 860 N. 12th East, Logan, UT 84321, (801) 752-1311

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM), and Intermountain Forest and Range Experiment Station (IF&RES)

FUNDING AMOUNT: FY77 \$1,000

DURATION: 6/73 - 1978

LOCATION: MT - Big Horn County (Decker), ID, UT

DESCRIPTION: Problem - In semi-arid areas of the West, establishment of vegetation on surface mine spoils may require supplemental irrigation for one or more growing seasons, especially during periods of dry growing seasons. Some areas may require an initial period of supplemental irrigation for successful plant cover establishment in almost any year. Accordingly, what are the irrigation requirements under such conditions and how effective are they? How long do they last? Objectives - To determine the effectiveness of supplemental irrigation and the duration of its effectiveness after termination of establishment

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of vegetation on semi-arid and mine spoils. Approach - Compare irrigated and non-irrigated blocks of research plots for survival, growth, and production of revegetated plant materials.

PUBLICATIONS: Contact SEAM, USDA Forest Service, 145 Grand Ave., Billings, MT 59102, for information on publications.

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PROJECT TITLE: Develop Grass, Shrub, and Tree Planting Techniques on Coal Surface Mine Spoils

INVESTIGATORS/ORGANIZATION: S. Monson, B.Z. Richardson, N. Frischknecht, P.E. Packer, USDA Forest Service, IF&RES, 860 N. 12th E, Logan, UT 84321, (801) 752-1311

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM), and Intermountain Forest and Range Experiment Station (IF&RES)

FUNDING AMOUNT: FY77 \$2,000 (SEAM), \$4,000 (IF&RES)

DURATION: 10/75 - 12/78 LOCATION: MT - Big Horn Co. (Decker), WY, UT

DESCRIPTION: Problem - Techniques for establishing grass, shrub, and tree vegetation on arid and alkaline coal mine spoils need to be developed or improved. Objective - To determine methods that are best suited for establishing such covers at Decker, Black Thunder and Alton coal surface-mining sites. Approach - Following bioassays to determine suitability of species, field trials on spoils using alternative season, depth, fertilizer, supplemental irrigation, mulch, etc. combinations.

PUBLICATIONS: Contact SEAM, USDA Forest Service, 145 Grand Ave., Billings, MT 59102 for information on publications.

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PROJECT TITLE: Development of Improved Varieties of Grasses Tolerant to Acid and Saline Soils for Reclamation of Surface-Mined Areas

INVESTIGATORS/ORGANIZATION: D. Dewey, K. Asay, USDA Forest Service, Intermountain Forest and Range Experiment Station, 860 N. 12th East, Logan, UT 84321, (801) 752-1311

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM), and Intermountain Forest and Range Experiment Station (IF&RES); Also U.S. Environmental Protection Agency

FUNDING AMOUNT: FY77 \$12,000 (SEAM), \$9,000 (IF&RES), \$4,000 (EPA)

DURATION: 6/75 - 6/79 LOCATION: MT, UT, ID

DESCRIPTION: Problem - Revegetation of highly-acid and highly-saline surface mine spoils and tailings requires plants that are especially tolerant of these

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extreme pH conditions, as well as tolerant of high concentrations of dissolved heavy metals or semi-metals that are toxic. Objectives - Develop new genetic strains or varieties of agropyron, elynobes, and hordblurm grasses that are especially tolerant to extreme pH and metal toxicity conditions. Approach - Utilize expert knowledge and progress of A.R.S. grass genetics research project at Logan to develop these improved genotypes.

PUBLICATIONS: Contact SEAM, USDA Forest Service, 145 Grand Ave., Billings, MT 59102 for information on publications.

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PROJECT TITLE: Development of Microenvironmental Instrumentation to Monitor Conditions on Mine Spoils

INVESTIGATORS/ORGANIZATION: Ray W. Brown, Robert S. Johnston, B.Z. Richardson, Paul E. Packer, USDA Forest Service, Intermountain Forest and Range Experiment Station, 860 N. 12th East, Logan, UT 84321, (801) 752-1311

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM), and Intermountain Forest and Range Experiment Station (IF&RES)

FUNDING AMOUNT: FY77 \$1,000 (SEAM), \$1,000 (IF&RES)

DURATION: 7/72 - 9/73

LOCATION: MT, ID, UT, WY

DESCRIPTION: The environmental conditions on Western arid harsh mine sites are severe, but no quantitative data are available to document this. Such factors as soil water potential, soil surface temperature, relative humidity, wind and radiation can be extremely severe on mine sites. The objective here would be to contrast these conditions on mined areas with those on adjacent unmined areas in order to determine to what extent rehabilitation techniques are needed to ameliorate the site. Two such instrumentation systems were installed on an alpine mine in 1975 but instrumentation problems prevented full-season monitoring. Obviously more development is needed. Unfortunately this is expensive research and has not received the backing needed to pursue it. However, the work will continue where possible, if sufficient funds become available.

PUBLICATIONS: Contact, SEAM, USDA Forest Service, 145 Grand Ave., Billings, MT 59102 for information on publications.

222

PROJECT TITLE: Development of Premining and Reclamation Plan Rationale (BOM No. J0255002)

INVESTIGATORS/ORGANIZATION: Al Pernichele, H. Lloyd Brown, B.G. Randolph, Geoffrey Walton, Dames and Moore, 605 Parfet, Denver, CO 80215, (303) 232-6262

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Mines

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FUNDING AMOUNT: \$150,000 DURATION: 6/75 - 6/76 (Phases 2 & 3 were cancelled)

LOCATION: A site in one of the 27 states containing surface minable coal.

DESCRIPTION: Step-by-step instructions for compiling the wide range of technical, environmental, geologic, and other data needed to get Federal and State permission to start a surface coal mine were compiled in this study. Guidelines were also prepared for pre-mining and reclamation plans required by various regulatory agencies. The study was based on laws in effect as of January 1976.

PUBLICATIONS: Development of Pre-Mining and Reclamation Plan Rationale for Surface Coal Mines, Vols. I, II, III. Available from NTIS (PB258 041/set). \$20.50 in paper copy, \$7.00 in microfiche.

223

PROJECT TITLE: Effects of Different Rehabilitation Treatment Methods on Surface Runoff Quantity and Quality and Erosional Behavior of Surface Mine Spoils in the Intermountain West

INVESTIGATOR/ORGANIZATION: Paul E. Packer, USDA Forest Service, Intermountain Forest and Range Experiment Station, 860 N. 12th East, Logan, UT 84321, (801) 752-1311

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM), and Intermountain Forest and Range Experiment Station (IF&RES)

FUNDING AMOUNT: FY77 \$2,000 (SEAM), \$8,000 (IF&RES) DURATION: 1/74 - 12/78

LOCATION: ID, MT

DESCRIPTION: Problem - Where surface runoff and erosion from mine spoils hold potentials for damaging water quality and other elements of the environment, there is a need to evaluate alternative rehabilitation measures to determine which are most effective for reducing or preventing adverse environmental impacts. Objectives - To determine the relative effectiveness of alternative surface mine rehabilitation methods for stabilizing the runoff and erosional regimes. Methods and Analysis - Semi-permanent runoff and erosion plots installed in the field; results subjected to variance analyses.

PUBLICATIONS: Contact SEAM, USDA Forest Service, 145 Grand Ave., Billings, MT 59102 for information on publications.

224

PROJECT TITLE: Effect of Selective Replacement of Coal Surface Mine Overburden Strata on Soil and Hydrology Relationships

INVESTIGATORS/ORGANIZATION: Douglas J. Dollhopf, Richard L. Hodder, I.B. Jensen, W.D. Hall, Montana Agricultural Experiment Station, Montana State Univ., Bozeman, MT 59715, (406) 994-4821

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FUNDING AGENCY: U.S. Department of the Interior, Bureau of Mines

FUNDING AMOUNT: \$1,060,721 (FY77 \$443,488) DURATION: 6/76 - 6/79

LOCATION: MT - Rosebud County (Colstrip)

DESCRIPTION: The intent of this project is to thoroughly characterize overburden at a proposed mine site and design and implement innovative techniques to protect the integrity of the ground water system by selective overburden handling; to monitor the systems to determine treatment effectiveness; to include effective techniques into mining plans in order to maximize efficiency of innovative mining techniques.

PUBLICATIONS: Report I: Selective Replacement of Coal Strip Mine Overburden in Montana.

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PROJECT TITLE: Effects of Coal Strip Mining on Vegetation and Soil Water Relationships

INVESTIGATORS/ORGANIZATION: Douglas J. Dollhopf, Richard Hodder, Animal and Range Sciences Dept., Montana Agricultural Experiment Station, Montana State Univ., Bozeman, MT 59715, (406) 994-4821

FUNDING AGENCY: Peabody Coal Company DURATION: 7/75 - Continuing

FUNDING AMOUNT: Approx. \$30,000/year LOCATION: MT

DESCRIPTION: Employing neutron probe techniques the soil water flow characteristics in spoils is being modeled. The same is being done on adjacent native range areas. Solute movement at these same locations is being correlated to the soil water flow.

PUBLICATIONS: Annual reports to Peabody Coal Company.

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PROJECT TITLE: Effects of Fertilizer Rate and Duration of Application on a Mine Spoil Revegetation Planting

INVESTIGATORS/ORGANIZATION: Edward J. DePuit, W.H. Willmuth, Richard L. Hodder, Dept. of Animal and Range Science, Montana Agricultural Experiment Station, Montana State Univ., Bozeman, MT 59715, (406) 994-4821

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM)

FUNDING AMOUNT: FY77 \$6,000; Prior, Approx. \$18,200

DURATION: 6/74 - 9/78 LOCATION: MT - Rosebud Co. (Colstrip)

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DESCRIPTION: This long-term study was initiated during 1974 with the following objectives: (1) To determine the rate of establishment, productivity and long-term survival of a perennial seed mixture as affected by rate of fertilizer application; (2) To determine the effectiveness of these fertilizer applications in a Spring and Fall seeding; (3) To determine the optimum duration of annual maintenance fertilization. Patterns of vegetation establishment of all treatments are being monitored annually by sampling for plant productivity, cover, frequency and diversity. Intensive soil sampling is conducted to determine soil nutrient patterns and fertilizer utilization under differing fertilization regimes.

PUBLICATIONS: (1) Effects of Fertilizer Rate and Time of Application on a Mine Spoils Rehabilitation Planting, Annual Report 1974-75; (2) R.L. Meyn, J. Holechek, and E. Sundberg. Short and Long-Term Fertilizer Requirements for Reclamation of Mine Spoils at Colstrip, Montana. 1975; (3) Proceedings - Fort Union Coal Field Symposium, Billings, Montana, April 25-26, 1975.

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PROJECT TITLE: Effects of Species Root Distribution in Soil Biota-Genesis Hydrological Characteristics

INVESTIGATORS/ORGANIZATION: G. A. Nielsen, K. Temple, D.J. Dollhopf, Animal and Range Science Dept., Montana Agricultural Experiment Station, Montana State Univ., Bozeman, MT 59715, (406) 994-4821

FUNDING AGENCY: U.S. Department of Agriculture, Cooperative State Research Serv.

FUNDING AMOUNT: \$110,000

DURATION: 10/75 - 12/77

LOCATION: MT - Rosebud Co. (18 study sites near Colstrip)

DESCRIPTION: Objectives - Determine the genesis, classification and evaluation of soils developing from coal strip mine spoil materials, measure microbial activity in relation to plant roots, determine rooting depths and growth patterns, determine the unsaturated soil water flow patterns and correlate hydrology data with root growth results, and formulate recommendations for optimizing soil development on reclaimed spoils. Approach - Eighteen study sites are selected near Colstrip in southeastern Montana. Mined sites are from 1 to 50 years old. Unmined sites in native range and cultivated areas are on benchmark soil series. Methods will include time sequence monitoring, P32 uptake for root growth pattern, ATP measurements for rhizoplane, rhizosphere and total soil microbial activity and neutron probe equipment for soil water movement.

PUBLICATIONS: Soil Genesis, Hydrological Properties and Root Characteristics, Progress Report I, April 1977, MAES Research Report 108.

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PROJECT TITLE: Energy-Related Graduate Traineeship Program

INVESTIGATOR: Kenneth J. Goering (now retired), Montana State Univ., Bozeman, MT 59715

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FUNDING AGENCY: U.S. National Science Foundation

FUNDING AMOUNT: \$57,900 (FY77 \$21,000)

DURATION: 9/74 - 8/78

LOCATION: MT

DESCRIPTION: The objectives of present studies are to reduce undesirable effects of coal surface mining and restore or create a desirable and productive environment in the shortest practical time. Associated objectives are designed to: (1) Determine methods and criteria for the establishment of effective and desirable plant cover for permanent protection of mined lands under the varied environmental conditions encountered; (2) Study, analyze, and define economically feasible standards and requirements for reclamation practices adopted to the Montana Strip Mining and Reclamation Act of 1973; (3) Develop methods for minimizing water, soil and air pollution; (4) Preserve, restore, or enhance the natural beauty of affected lands; (5) Develop and promote coordinated mining and reclamation techniques; (6) Develop and evaluate specific reclamation preplanning technology as a basis upon which to determine the feasibility of mining, mining techniques required, reclamation techniques necessary, and to form the irrefutable basis upon which to judge reclamation success.

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PROJECT TITLE: Erodibility of Topsoil and Spoil Material by Water

INVESTIGATORS/ORGANIZATION: William Hartsog, Edward Burroughs, USDA Forest Service, Intermountain Forest and Range Experiment Station, Forestry Sciences Laboratory, P.O. Box 1376, Bozeman, MT 59715, (406) 994-4852

FUNDING AGENCY: U.S. Environmental Protection Agency, Cincinnati National Environmental Research Center, Cincinnati, OH

FUNDING AMOUNT: \$117,500 to date

DURATION: 1/76 - 12/79

LOCATION: MT, ND, WY

DESCRIPTION: The objectives are to (1) Develop a technique that can be used in the field or laboratory to measure the erodibility of topsoil and spoil materials; (2) Correlate these measurements of erodibility with other 'standard' methods and techniques; (3) Develop methods for estimating erodibility using the physical characteristics of topsoil and spoil materials. A small portable rainulator has been built and is being tested in the laboratory on selected spoil materials to discover those physical and chemical properties which have the greatest effect upon erodibility.

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PROJECT TITLE: Establishment, Composition and Productivity of Species Adapted to Areas Disturbed by Strip Mining

INVESTIGATORS/ORGANIZATION: Martin Burris, Loren Wiesner, Montana Agricultural Experiment Station, Bozeman, MT 59717, (406) 994-3681

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FUNDING AGENCY: U.S. Department of Agriculture, Cooperative State Research Service; Montana Agricultural Experiment Station (In kind support); U.S. EPA

FUNDING AMOUNT: \$30,000 (USDA), \$15,000 est. (MAES)

DURATION: 9/75 - 12/79

LOCATION: MT - Rosebud Co. (Colstrip area)

DESCRIPTION: Objectives - (1) Evaluate the productivity and composition change of native species recently established on mine spoils; (2) Evaluate naturalized species to determine their establishment and productivity characteristics; (3) Continue to develop methods for overcoming seed dormancy of species which show promise for use in reclaiming mine spoils; and (4) Evaluate the buildup of a dormant seed population on reclaimed areas in comparison to that present in undisturbed areas. Approaches - (1) Research plots established in 1976 will be evaluated to determine the change in species composition and forage production. These plots contain ten different native species; (2) Field plantings will be made on strip mined areas to determine the establishment, productivity, and adaptivity of introduced species; (3) Dormant seeds will be subjected to treatments such as scarification, presoaking, prechilling, and various chemicals and plant hormones; (4) Soil cores will be taken from 5-year-old stands established on mine spoils and from undisturbed areas. Cores will be sectioned and the number of seeds in each section will be determined. If possible, seeds will be identified and their viability determined.

PUBLICATIONS: (1) Annual reports; (2) Handbook on Species and Their Establishment Practices

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PROJECT TITLE: Establishment, Succession, and Stability of Vegetation on Surface Mined Lands in Eastern Montana

INVESTIGATORS/ORGANIZATION: Brian W. Sindelar, Animal and Range Sciences Dept., Montana State Univ., Bozeman, MT 59715, (406) 994-3721; G.A. Nielsen, Plant and Soil Sciences, Dept., Montana State Univ.

FUNDING AGENCY: U.S. Energy Research and Development Administration

FUNDING AMOUNT: \$126,000 to date

DURATION: 6/75 - 6/82

LOCATION: MT - Rosebud Co. (sites near Colstrip)

DESCRIPTION: Because data concerning the permanence and stability of plant communities established on surface mined lands in the West are not available, the potential long term success of current reclamation technology is unknown. The purpose of this study is to document establishment and successional changes in plant communities occurring on surface mined lands in semi-arid eastern Montana. An intensive vegetation and soil monitoring program on both abandoned and active surface mining sites near Colstrip, Montana, was initiated in June 1975. It will document rates and trends of ecological succession on lands mined from 53 years ago to the present. Thirteen fenced enclosures on recent reclamation plantings and naturally revegetated abandoned spoils were established. Transects were set up in each enclosure for analyses of plant community

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parameters. Initial plant species lists and plant collections were prepared. Stereophotography and cover and production estimates on permanent quadrats will record vegetational development and soil sampling will monitor soil development. The project is coordinated with other energy research in the area which will provide it with additional data. Project duration is a minimum of five growing seasons. Response of vegetation to weather fluctuations including heat and drought is of major concern.

PUBLICATIONS: Annual progress reports to ERDA.

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PROJECT TITLE: The Establishment of Vegetation on High Sodium Content Mine Spoils -- Decker, Montana

INVESTIGATORS/ORGANIZATION: B.Z. Richardson, R.W. Brown, E.E. Farmer, Paul E. Packer, USDA Forest Service, Intermountain Forest and Range Experiment Station, 860 No. 12th East, Logan, UT 84321, (801) 752-1311

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM); Intermountain Forest and Range Experiment Station (IF&RES)

FUNDING AMOUNT: FY77 \$2,000 (SEAM), \$2,000 (IF&RES)

DURATION: 7/73 - 9/79

LOCATION: MT - Big Horn Co. (Decker)

DESCRIPTION: Objectives - (1) Determine the minimum combination of treatments necessary to achieve an acceptable stand of grass, shrubs, and trees; (2) To assess the short- and long-term merits of grass mixtures consisting of (a) all introduced grasses, (b) all native grasses, and (c) native plus introduced grasses.

PUBLICATIONS: P.E. Packer, et al. Revegetation Research on the Decker Coal Mine in Southeastern Montana, USDA Forest Service, Res. Paper INT-162, 1974; Also P.E. Packer, et al. Rehabilitation Research and Its Application on a Surface Mined Area of Eastern Montana. Fort Union Coal Field Symposium, Vol. 3, pp. 247-265.

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PROJECT TITLE: Evaluate and Determine Species Adaptability on Surface Mined Overburden and Spoils Resulting from Coal Mining in Eastern Montana Assessed by Greenhouse Bioassay Techniques

INVESTIGATORS/ORGANIZATION: B.Z. Richardson, E.E. Farmer, P.E. Packer, USDA Forest Service, Intermountain Forest and Range Experiment Station, 860 N. 12 St. E, Logan, UT 84321, (801) 752-1311

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM), and The Intermountain Forest and Range Experiment Station (IF&RES)

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FUNDING AMOUNT: FY77 \$1,000 (SEAM), \$2,000 (IF&RES)

DURATION: 1974 - 1977

LOCATION: MT

DESCRIPTION: Problem - Spoil materials usually contain many characteristics and chemical substances that are not conducive to plant emergence, survival and growth. Objective - To determine germination and emergence through bioassay technique of desirable grasses. Approach - Plants will be measured for emergence as well as shoot growth during a period of thirty days. Plants will then be evaluated in terms of root and shoot growth.

PUBLICATIONS: Contact SEAM, USDA Forest Service, 145 Grand Avenue, Billings, MT 59102 for information on publications.

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PROJECT TITLE: Evaluation of Solid Waste as Physical and Chemical Amendments in Revegetation of Coal Surface Mine Spoils

INVESTIGATOR/ORGANIZATION: Robert L. Sanks, Dept. of Civil Engineering, Montana State University, Bozeman, MT 59715, (406) 994-2111

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM); Montana State University

FUNDING AMOUNT: \$32,814 (\$27,006 SEAM; \$5,808 MSU)

DURATION: 6/75 - 8/76 (This was an exploratory study designed to install a test site at Peabody Coal Company, Colstrip. Technical difficulties and underfunding required postponing the field installation until more funds could be obtained.)

LOCATION: MT - Rosebud Co. (Colstrip)

DESCRIPTION: The general objectives of this study are to develop techniques for and to evaluate the effects of using municipal solid wastes and wastewater treatment plant sludge as physical and chemical amendments in the revegetation of coal surface-mine spoils in the vicinity of Colstrip. The overall objectives include all phases of physical handling and economics, chemical analysis of solid waste constituents, effects of pulverized solid wastes, and the impact of disposing of solid wastes in this manner. The specific objectives of the subject for the 1975-1976 study period include: limited chemical analyses of wastes and sludges, establishment of reclamation plots at Colstrip where pulverized solid wastes would be spread, seeding the plot with various grasses, field measurements and laboratory analyses to compare effects of amendments with bare soil conditions, and need and priorities for continuing studies.

PUBLICATIONS: Final report, August 1976.

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PROJECT TITLE: Flexible Cultural Practices for Establishment of Perennial and Annual Vegetation on Topsoiled Stripmines

INVESTIGATORS/ORGANIZATION: Martin J. Burris, Loren Wiesner, James Krall, Montana Agricultural Experiment Station, Montana State Univ., Bozeman, MT 59717, (406) 994-3681

FUNDING AGENCY: U.S. Department of Agriculture, Cooperative State Research Service; Montana Agricultural Experiment Station; U.S. EPA

FUNDING AMOUNT: \$65,000 (\$45,000 USDA; \$20,000 MAES-in kind support est.)

DURATION: 8/77 - 12/79

LOCATION: MT - Coal mining areas

DESCRIPTION: Objectives - (1) To assess the capabilities of several annual and perennial crop species to function as barriers for the trapping and retention of winter snowfall; (2) To determine if snow retention increases seedling establishment and subsequent growth of a forage mixture, if increased snow retention on a site affects maturity of the seed crop and to monitor species composition changes associated with increased snow cover, increased soil moisture and reduced winter exposure on barrier vs. non-barrier sites; (3) Utilizing annual nurse crops, stubble seeding techniques and frost seeding techniques, to determine their impact on the success of perennial forage seedings on spoils materials; and (4) Growing a green manure crop on stockpiled topsoil to determine if a significant decrease in weed seed and increase in nitrogen content can be made over uncropped stockpiled topsoil. Approaches - (1) Several annual and perennial grasses and forbs including wheat, barley, oats, flax, sunflowers, tall wheatgrass, sudangrass, sorghum and others will be planted in strips and will be evaluated for their ability to trap snow; (2) Various forage mixtures will be seeded between barriers to evaluate establishment as it relates to moisture levels; (3) Several annual crops will be seeded to evaluate establishment of forage species using nurse crops, stubble seeding techniques and frost seeding techniques; (4) A portion of stockpiled topsoil will be seeded with several green manure crops.

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PROJECT TITLE: Hanging Woman Reclamation Study Area

INVESTIGATORS/ORGANIZATION: Robert Delk, Jim Culbertson, Rich Ebens, Dick Hadley, Wayne Van Voast, c/o U.S. Department of the Interior, Bureau of Land Management, EMRIA Rehab. Data Staff, Denver Fed. Center, Denver, CO 80225

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Land Management, Energy Minerals Rehabilitation Inventory and Analysis Program (EMRIA); and USDI, Geological Survey, Water Resources Division

FUNDING AMOUNT: FY77 \$88,000 BLM, \$15,000 USGS

DURATION: 10/76 - 9/79

LOCATION: MT - Big Horn Co. (Hanging Woman Creek Tributary)

DESCRIPTION: The Hanging Woman Reclamation Study Area is a BLM coordinated interagency effort. Geologic mapping, hydrologic investigations and geochemical

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characterizations are conducted by the USGS. Montana Bureau of Mines and Geology is assisting in groundwater investigations and supervising the drilling. The study boundary is the E. Fork of Trail Creek Watershed. Approximately 15 miles. The objective is a pre-mining characterization of the hydrology and geology of the watershed.

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PROJECT TITLE: Hydromulching as an Alternative Mulching Method on High Sodium Surface Mine Disturbances

INVESTIGATORS/ORGANIZATION: B.Z. Richardson, P.E. Packer, USDA Forest Service, Intermountain Forest and Range Experiment Station, 860 N. 12th East, Logan, UT 84321, (801) 752-1311

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM) and The Intermountain Forest and Range Experiment Station (IF&RES)

FUNDING AMOUNT: FY77 \$2,000 (SEAM), \$2,000 (IF&RES) DURATION: 10/73 - 10/78

LOCATION: MT

DESCRIPTION: Problem - Previous data indicate that surface mulches provide favorable environmental conditions for the establishment of a plant cover on surface mine overburden materials. Many types of mulch and their application are prohibitively expensive for treating large areas. Hydro-applications of mulch offers an alternative method that would be economical. Objectives - (1) To test the effectiveness of wood fiber as a mulch for the establishment of grass seedlings; (2) To determine suitable methods of application. Methods - A 500 gallon bowie hydromulching unit was used for application of seed, fertilizer, and wood-fiber mulch to various surface mine overburden materials. In addition, seed was also applied with a standard seed packer prior to hydromulching and fertilization. Results - Comparisons of dry-matter production among the various methods of mulch, seed and fertilizer applications will be made.

PUBLICATION: Contact, SEAM, USDA Forest Service, 145 Grand Ave., Billings, MT 59102, for information on publications.

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PROJECT TITLE: The Influence of Topsoil Depth on Plant Cover Establishment and Growth on Sodic Coal Mine Overburden Piles

INVESTIGATORS/ORGANIZATION: B.Z. Richardson, E.E. Farmer, P.E. Packer, USDA Forest Service, Intermountain Range and Forest Experiment Station, 860 N. 12th E., Logan, UT 84321, (801) 752-1311

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM) and Intermountain Forest and Range Experiment Station (IF&RES)

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FUNDING AMOUNT: FY77 \$2,000 (SEAM), \$4,000 (IF&RES)

DURATION: 4/76 - 1/78

LOCATION: MT - Big Horn Co. (Decker)

DESCRIPTION: One of the greatest needs in the coal mining area is to determine the amount of topsoil needed to revegetate coal mine spoils. The state of Montana requires by law eight feet of topsoil which is impossible. This study will relate topsoil depth and selected soil and spoil properties to total plant biomass. Multiple regression analysis will be utilized to ascertain the influence of main effects and interactions.

PUBLICATIONS: Contact SEAM, USDA Forest Service, 145 Grand Ave., Billings, MT 59102 for information on publications.

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PROJECT TITLE: Measurement and Simulation of Physical Transformation of Overburden Materials With Time

INVESTIGATORS/ORGANIZATIONS: Donald R. Reichmuth, Alfred C. Scheer, Dept. of Civil Engineering, Montana State Univ., Bozeman, MT 59715; Edward Burroughs, USDA Forest Service, Forestry Sciences Lab., Box 1376, Bozeman, MT

FUNDING AGENCY: U.S. Environmental Protection Agency, Cincinnati Environmental Research Center, Cincinnati, OH; USDA Forest Service, SEAM Program

FUNDING AMOUNT: Approx. \$164,000 to date (EPA) DURATION: 6/75 - 6/79

LOCATION: MT, ND

DESCRIPTION: Drill logs are being correlated with observations of geologic formations in mine headwalls to develop better techniques for recognizing overburden materials with characteristics of particular importance for aquifer reconstruction. Overburden excavation and spoils placement operations are being studied in detail to predict where and how material from a particular formation will be deposited in a spoil pile. Objectives are to: predict the physical transformations of overburden materials that affect hydrologic functioning and mass stability with time; determine the most efficient techniques for measuring and/or simulating physical transformations over time in order to predict the resulting physical and hydrologic characteristics; derive predictive equations for these characteristics that affect water quality and plant establishment to develop prescriptions for effective spoils placement.

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PROJECT TITLE: Natural Recurrence of Microbial Populations in Reclaimed Areas (WELUT No. 055-77)

INVESTIGATOR/ORGANIZATION: J.B. Skaptason, Biosearch & Development, Inc. Kansas City, MO

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team; Old West Regional Commission

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FUNDING AMOUNT: \$78,789 (50% OWRC, 50% FWS)

DURATION: 6/77 - 5/78

LOCATION: Western coal region

DESCRIPTION: This study will identify and quantify soil microbial populations in replaced topsoils, reclaimed soils, orphaned site soils, and undisturbed soils. Soil physical and chemical properties important to microbial populations and their sustaining life processes of soils and spoils will be determined. Treatments applied to reclaimed areas (amendments, surface manipulation, and irrigation) along with species and vigor of plants present will be evaluated and documented.

PUBLICATIONS: A report discussing introductory and background information, pertinent literature review, methods of data collection and analysis, results, discussion and interpretation of results, and narrative and tabular information and maps relating to the occurrence of microbial populations on undisturbed sites, their recurrence on disturbed sites, and the apparent conditions responsible for differences.

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PROJECT TITLE: Nitrogen Fixation in Non-Leguminous Plants Used For Surface Mine Revegetation

INVESTIGATORS/ORGANIZATION: Ray W. Brown, Paul E. Packer, USDA Forest Service, Intermountain Forest and Range Experiment Station, 860 N. 12th East, Logan, UT 84321, (801) 752-1311

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM) and Intermountain Forest and Range Experiment Station (IF&RES)

FUNDING AMOUNT: FY77 \$3,000 (SEAM), \$1,000 IF&RES

DURATION: 7/75 - Continuing

LOCATION: ID, MT, UT

DESCRIPTION: The initial phases of the research are being done with a prostrate shrub, *ceanothus prostratus*, a nitrogen fixing plant native to the east slope of the Sierra Nevada Mountains. Extensive nodule development on the root system is common, and the indigenous sybiote appears to be an actinomycete, a fungi. The main problems remaining appear to be to develop methods of innoculating the actinomycete in new planting areas to infect the root systems of recently rooted cuttings. Also, we need to identify adapted ecotypes and propagate them for outplanting. Established outplantings now about 10 years old in the intermountain area display a number of adapted ecotypes, and research is now underway to propagate rooted stock and outplant them to new localities, particularly mine spoil sites.

PUBLICATIONS: Contact SEAM, USDA Forest Service, 145 Grand Ave., Billings, MT 59102 for information on publications.

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PROJECT TITLE: Otter Creek East Reclamation Site-Overburden Investigation

INVESTIGATORS/ORGANIZATIONS: H.P. Dupree, USDI Bureau of Reclamation, P.O. Box 2553, Billings, MT 59103; Fred Waldhaus, USDI, Bureau of Land Management, 316 N. 26th St., Billings, MT 59101

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Land Management, Energy Minerals Rehabilitation Inventory and Analysis Program (EMRIA)

FUNDING AMOUNT \$9,600

DURATION: 4/76 - 5/77 (Completed)

LOCATION: MT - Powder River Co. (Otter Creek East)

DESCRIPTION: To collect baseline conditions on vegetation, soil, overburden, coal resource, substrata below the coal and other environmental factors. From these data release stipulations can be formulated. A soils inventory will be accomplished. Subsurface data will be determined from core samples.

PUBLICATIONS: Final report available from U.S. BLM, 316 N. 26th St., Billings, MT 59101

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PROJECT TITLE: Photo Interpretation as a Tool for Assessing the Revegetation of Surface Mined Areas

INVESTIGATORS/ORGANIZATION: B.Z. Richardson, P.E. Packer, USDA Forest Service, Intermountain Forest and Range Experiment Station, 860 N. 12th East, Logan, UT 84321, (801) 752-1311

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM)

FUNDING AMOUNT: FY77 \$1,000

DURATION: 7/73 - 7/78

LOCATION: MT, ID

DESCRIPTION: Problem - Normal plot assessment techniques of revegetation efforts do not provide as complete a record of stand characteristics as is often desired. Moreover, standard techniques would provide a permanent record of stand characteristics which the investigator can refer to at any time. Objectives - (1) To provide a permanent pictorial record of revegetation plots at successive time intervals; (2) To develop photogrammetric techniques of data collection. Results - This study will result in a list of procedures, techniques, and equipment needed for photographic evaluation of vegetation. Evaluations will be made to determine the feasibility of facilitating species identification, plant density, and other critical stand characteristics.

PUBLICATIONS: Contact SEAM, USDA Forest Service, 145 Grand Ave., Billings, MT 59102 for information on publications.

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PROJECT TITLE: Plant Response and Livestock Performance on Coal Mine Spoils Pastures

INVESTIGATORS/ORGANIZATION: Edward J. DePuit, Richard L. Hodder, Dept. of Animal and Range Sciences, Montana Agricultural Research Station, Montana State Univ., Bozeman, MT 59715, (406) 994-4821

FUNDING AGENCIES: Western Energy Company, Butte, MT; U.S. Department of Agriculture, Cooperative States Research Service

FUNDING AMOUNT: FY77 \$16,530, prior \$25,000 (WECO); FY77 \$30,845 (USDA)

DURATION: 1/76 - 12/80

LOCATION: MT - Rosebud Co. (Colstrip)

DESCRIPTION: The overall objective of the research is to determine if a given type of spoil vegetation as produced in the reclamation process is productive, stable, and useful under proper management. Specific objectives for the field trials at Colstrip during the 1976 funding period are the following: (1) Evaluate the quality of spoils vegetation with livestock use throughout the grazing period from early spring through late fall; (2) Determine the relative merits of season-long grazing of spoils vegetation vs. a complementary spoils-rangeland grazing system; (3) Determine the degree and significance of compaction of spoil material caused by trampling effects of livestock; (4) Analyze the successional response of mine spoil plant communities that occurs under a given system of livestock grazing; and (5) Evaluate the influence of grazing on mine spoil vegetation in scatter of seed plant yield, accumulation of organic matter and soil fertility.

PUBLICATION: E.J. DePuit, W.H. Willmuth, J.G. Coenenberg. Plant Response and Forage Quality for Controlled Grazing on Coal Mine Spoils Pastures. Montana Agr. Exp. Station Research Report, 1976.

245

PROJECT TITLE: Plant and Soils Reclamation Research on Strip Mined Lands

INVESTIGATOR/ORGANIZATION: Richard L. Hodder, Douglas J. Dollhopf, Animal and Range Sciences Dept., Montana Agricultural Research Station, Montana State Univ., Bozeman, MT 59715, (406) 994-4821

FUNDING AGENCY: Decker Coal Company, Decker, Montana

FUNDING AMOUNT: Approx. \$20,000/year

DURATION: 7/75 - Continuing

LOCATION: MT

DESCRIPTION: Employing neutron probe techniques the soil water flow characteristics in spoils is being modeled. The same is being done on adjacent native range areas. Solute movement at these same locations is being correlated to the soil water flow. The effects of gypsum and calcium chloride on reclamation of saline-alkali spoils is being investigated.

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PROJECT TITLE: Pumpkin Creek, Montana Reclamation Study Area

INVESTIGATORS/ORGANIZATION: Herman K. Dupree, Harold Ward, Richard Hadley, Ed Landis, c/o USDI, Bureau of Land Management, EMRIA, Rehab Data Staff, D-307, Bldg. 50, Denver Federal Center, Denver, CO 80225

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Land Management, Energy Minerals Rehabilitation Inventory and Analysis Program (EMRIA)

FUNDING AMOUNT: FY77 \$180,000

DURATION: 10/76 - 9/77 (Completed)

LOCATION: MT - Powder River Co. (near Broadus)

DESCRIPTION: Purpose - To establish baseline conditions on soil, overburden, coal resource, surface and ground water quantity and quality, vegetation and sedimentation of Pumpkin Creek site being considered for mining. From these data guidance for preparation of stipulations in future leases will be prepared. Alternate reclamation techniques and vegetation types will be prepared. Water monitors will remain on site until baseline conditions are established or until no further changes are anticipated if the area is mined and reclaimed. Chemical and physical data obtained on all geologic strata to a depth of approximately 200 feet.

PUBLICATIONS. Pumpkin Creek Reclamation Study Area. USBR/USGS, 11-1977. Due December 1977. Available from USDI, Bureau of Land Management, 316 N. 26th St., Billings, MT 59101.

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PROJECT TITLE: Reclamation Potential of Energy Disturbed Lands (WELUT No. 043-76)

INVESTIGATOR/ORGANIZATION: Paul E. Packer, USDA Forest Service, Intermountain Forest and Range Experiment Station, 860 N. 12th East, Logan, UT 84321 (801) 752-1311

FUNDING AGENCIES: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team; U.S. Environmental Protection Agency

FUNDING AMOUNT: \$82,500 (\$42,500 USDI, \$40,000 EPA)

DURATION: 6/76 - 12/77

LOCATION: MT, ND, WY, UT, CO, NM, AZ

DESCRIPTION: This project will develop and implement a standard qualitative evaluation of the rehabilitation potential of all major, strippable coal areas. This will include an inventory and survey of reclaimed areas in the states of MT, UT, WY, CO, NM, and AZ. A more detailed quantitative approach will also be investigated to determine the site and environmental variables important in evaluating rehabilitation potential of western coal areas and test the analytical, interpretative, and predictive capability of conceptual word and regression models.

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PUBLICATIONS: Products will include: (1) Maps delineating and describing rehabilitation response units in those areas of surface-mineable coal in the interior West, exclusive of the No. Great Plains; (2) Reclamation fact sheets for each major coal surface mine in the West. These will include site preparation for reclamation mine operations performed at reclamation site, climate of mine, etc.; (3) A report discussing the relationships that define the influences of significant independent and reclamation variables on vegetation characteristics that measures reclamation success and are useful for predicting reclamation potentials.

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PROJECT TITLE: Reduction of Sodium Content in Coal Mine Spoils With Time

INVESTIGATORS/ORGANIZATION: B.Z. Richardson, P.E. Packer, USDA Forest Service, Intermountain Forest and Range Experiment Station, 860 N. 12th East, Logan, UT 84321, (801) 752-1311

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM), and The Intermountain Forest and Range Experiment Station (IF&RES)

FUNDING AMOUNT: FY77 \$2,000 SEAM, \$1,000 IF&RES

DURATION: 9/72 - 9/77

LOCATION: MT - Big Horn Co. (Decker)

DESCRIPTION: Problem - High sodium spoils create a major problem in the successful revegetation of mine spoils in southeastern Montana. Objective - To measure the effect of time of the S.A.R. within the upper portion of the soil profile. Approach - Treatments will consist of topsoiling, watering, and chemical treatments.

PUBLICATION: Contact SEAM, USDA Forest Service, 145 Grand Ave., Billings, MT 59102 for information on publications.

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PROJECT TITLE: Reproductive Biology of *Artemesia* L in Eastern Montana

INVESTIGATORS/ORGANIZATION: T. Weaver, Steve Harvey, Botany Department, Montana State Univ., Bozeman, MT 59715, (406) 994-3270

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM), (through Mt. Department of Fish and Game)

FUNDING AMOUNT: \$10,000

DURATION: 7/74 - 12/77

LOCATION: MT - Rosebud Co. (Colstrip), WY, CO, ID, WA

DESCRIPTION: *Artemesia* species may be useful in reclamation of strip mined areas. This study compares the reproductive biology of five species to determine what the best methods of establishment might be. Phenology of *Artemesia* is described -

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timing of new leaves, flowers, etc. Planting methods are described - vegetative reproduction, seed reproduction - germination rates under different conditions, planting depths, survival rates for three years. Biomass-shrub size relationships are presented. Range of the species in Montana are presented. Soil water availability in principal vegetation types of E. Montana are under study still.

PUBLICATIONS: A bibliography (1000+ references) of pertinent literature will be a byproduct of this study.

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PROJECT TITLE: Restoration of Productivity to Areas Disturbed by Mining

INVESTIGATORS/ORGANIZATION: J.F. Power, F.M. Sandoval, R.E. Ries, No. Great Plains Research Center, USDA Agricultural Research Service, P.O. Box 459, Mandan, ND 58554, (701) 663-6448

FUNDING AGENCIES: U.S. Department of Agriculture, Agricultural Research Service; U.S. Environmental Protection Agency; USDA Forest Service, Surface Environment and Mining Program (SEAM)

FUNDING AMOUNT: USDA-ARS FY77 \$210,000, Prior \$700,000; USDA-FS FY77 \$70,000, Prior \$270,000; EPA FY77 \$160,000, Prior \$450,000

DURATION: 1/70 - Continuing

LOCATION: No. Great Plains

DESCRIPTION: Problem - Land is being disturbed and rendered non-productive by the large-scale mining operations in progress in the Northern Great Plains. Objective - To develop technology whereby the productivity potential -- as determined by the nature and extent of the natural resources available at a site -- of land disturbed by mining can be economically restored with minimum damage to the environment, so that this and future generations can have maximum flexibility in deciding post-mining uses of such land.

PUBLICATIONS: Numerous. Contact the No. Great Plains Research Center for a list.

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PROJECT TITLE: Revegetation Research at the Rosebud Mine, Colstrip, Montana

INVESTIGATORS/ORGANIZATION: Edward J. DePuit, Richard L. Hodder, Dept. of Animal and Range Sciences, Montana Agricultural Experiment Station, Montana State Univ., Bozeman, MT 59715, (406) 994-4821

FUNDING AGENCY: Western Energy Company, Butte, Montana

FUNDING AMOUNT: FY77 \$33,443, Prior \$252,739 DURATION: 1/68 - Continuing

LOCATION: MT - Rosebud Co. (Colstrip vicinity)

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DESCRIPTION: This project has been a long-term composite investigation of many facets concerning reclamation of coal strip mine spoils in Montana since 1968. Studies included to date involve vegetative species selection, fertilizer effects, topsoil depth and gradients, plant succession, seeding and planting techniques, machinery design, surface manipulation, erosion, percolation and infiltration characteristics, surface and ground water studies and many other related subjects. Research activities concerning this project are now concentrated on monitoring effects of established studies and the relative merits and effectiveness of applied treatments. Specific studies addressed during 1977 include the following: (1) Methods and procedures of establishing native plant species on mine spoils. Variables will include numbers and identity of species in seeded mixtures, seeding rate, and seeding method (broadcast vs. drill seeding); (2) Patterns of establishment of native vs. introduced plant species on mine spoils. Variables include seeding mixture and rate of fertilization; (3) Effectiveness of three plant species as green manure crops on mine spoils. Variables include species used and duration of manure cropping; (4) Feasibility of minimum tillage as a revegetation procedure on mine spoils; (5) Plant community successional studies on various previously established vegetation on mine spoils.

PUBLICATION: MAES Research Reports 8, 20, 40, 69, and 101. Annual progress reports and also special study reports.

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PROJECT TITLE: Salt Translocation in Saline-Sodic Mine Spoils

INVESTIGATORS/ORGANIZATION: Martin J. Burris, Douglas J. Dollhopf, M.G. Klages, Richard L. Hodder, Montana Agricultural Experiment Station, Montana State University, Bozeman, MT 59715, (406) 994-3681

FUNDING AGENCY: U.S. Department of Agriculture, Cooperative States Research Service.

FUNDING AMOUNT: \$68,000 (FY77 \$36,000)

DURATION: 7/76 - 9/78

LOCATION: MT - Big Horn Co. (Decker Coal Company providing research area)

DESCRIPTION: Geologically the coal rich Decker, Montana region tends to contain overburden materials with saline and/or sodic zones. Because of this fact the reclamation potential of these spoils is of concern. This study is intended to formulate specific recommendations for optimization of saline and/or sodic spoil reclamation. Research emphasis will be placed upon measurement of soil salt translocation over time and upon field identification of saline and/or sodic spoil problems. Identification of such problems in Montana spoils is a very complex problem. Salt distribution in these spoils is very heterogeneous and point sampling with core barrels, even in an intensive manner has not acceptably described the soil salt content. It is the intent of this study to test the 4-probe electrical resistivity method for measurement of soil salts. This technique is rapid, requires no soil sampling, and gives an integrated salt measurement over a large volume of soil.

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PROJECT TITLE: Selection of Suitable Plant Materials and Development of Plant Establishment Techniques

INVESTIGATORS/ORGANIZATIONS: Robert Lohmiller, USDA Soil Conservation Service, P.O. Box 970, Bozeman, MT 59715; John G. Scheetz, USDA SCS, Rt. 1, Box 81, Bridger, MT 59014

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM), and the U.S. Environmental Protection Agency

FUNDING AMOUNT: USDA \$116,375 (FY77 \$23,000); EPA \$172,500 (FY77 \$33,000)

DURATION: SEAM 4/74 - 10/78; EPA 8/75 - 10/80

LOCATION: MT, WY

DESCRIPTION: The purpose of this project is to accelerate selection and testing of plants for reclamation. A "Mined Land Reclamation Handbook" will be published when the project is completed.

PUBLICATIONS: Quarterly and annual progress reports.

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PROJECT TITLE: Soil Microbiological Studies on the Reclamation of Coal Surface Mine Spoils in Eastern Montana

INVESTIGATORS/ORGANIZATION: Edward J. DePuit, Kenneth Temple, Richard L. Hodder, Larry Hersmann, Dept. of Animal and Range Sciences, Montana Agricultural Experiment Station, Montana State Univ., Bozeman, MT 59715, (406) 994-4821

FUNDING AGENCY: Chevron Oil Company, Denver, CO

FUNDING AMOUNT: FY77 \$7,000; Prior \$20,000 DURATION: 7/74 - 12/77

LOCATION: Eastern MT

DESCRIPTION: Soil development on the spoils surface is now recognized as a prime factor determining the status of reclamation of coal surface mined lands and soil microbiological processes are of critical importance to this development. The initial phase of this project was concerned with determination of feasible, meaningful methods and procedures for monitoring microbiological processes on spoils, and some initial field measurements were conducted. The current phase of this project involves further field measurements of selected microbiological parameters (e.g., specific enzyme concentrations, ATP levels) on native soils and spoils in varying stages of reclamation to determine the present status of soil microbiological development and also to hopefully define cause-effect relationships. Ultimately, the goal of this research is to suggest and test practical solutions to soil microbiological problems associated with surface mined land reclamation.

PUBLICATIONS: (1) R.C. Stewart. An Investigation of Microbiological Parameters in the Revegetation of Coal Mine Spoils, M.S. Thesis, 1975. Also a MAES Research Report.

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PROJECT TITLE: Some Soil and Hydrologic Properties of Coal Mine Overburden Piles in Southeastern Montana

INVESTIGATORS/ORGANIZATION: Eugene E. Farmer, Bland Z. Richardson, Paul E. Packer, USDA Forest Service, Intermountain Forest and Range Experiment Station, 860 N. 12 East, Logan, UT 84321, (801) 752-1311

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM), and the Intermountain Forest and Range Experiment Station (IF&RES)

FUNDING AMOUNT: FY77 \$2,000 (SEAM), \$2,000 (IF&RES)

DURATION: 6/74 - Continuing

LOCATION: Southeastern MT

DESCRIPTION: Problem - The operational character of surface mining methods dictates that bare overburden materials shall be exposed to erosional forces from the time of mining until their successful revegetation. There is little existing information on the ways in which these bare overburden piles handle meteoric water, nor on the magnitude of surface erosion originating on these piles. Objectives - (1) To estimate the infiltration capacity of graded and ungraded surface mine overburden; (2) To assess the magnitude of surface erosion created by high intensity rainfall. Methods: The Rocky Mountain infiltrometer will be used in the determination of infiltration rates through the application of artificial rainfall. The equipment will be operated on both graded and ungraded spoil materials and the resulting sediments will be collected and analyzed. Results - Results will give a semi-quantitative indication of the infiltration and erodability characteristics of various spoil types. These data will also permit an assessment of relative erodabilities by spoil type, physiography, and degree of mechanical manipulation.

PUBLICATIONS: This work was reported to the Bituminous Coal Research, National Coal Association Symposium in October 1976.

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PROJECT TITLE: Survey of the Viability of Indigenous Grasses, Forbs, and Shrubs: Techniques of Initial Acquisition and Treatment for Propagation in Preparation for Future Land Reclamation in the Fort Union Basin

INVESTIGATOR/ORGANIZATION: Lee E. Eddleman, School of Forestry, University of Montana, Missoula, MT 59812, (406) 243-4573

FUNDING AGENCIES: U.S. Energy Research and Development Administration; U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM)

FUNDING AMOUNT: ERDA FY 77 \$13,708, Prior \$50,283; SEAM FY77 \$36,000

DURATION: 7/75 - 6/79

LOCATION: Southeastern MT

DESCRIPTION: The primary objectives of this project are to (1) Examine and inventory natural seed maturation and production characteristics of indigenous

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plant species in the Fort Union Basin; (2) Determine optimum seed collection, handling and storage procedures; (3) Determine the physical and chemical requirements for breaking seed dormancy; (4) Determine seed germination characteristics; (5) Study vegetative propagation characteristics using stem cuttings and rhizomes; and (6) Evaluate each species as to its potential for initial and followup spoil bank revegetation.

PUBLICATIONS: Annual progress reports.

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PROJECT TITLE: Tree, Shrub Transplant Project

INVESTIGATOR/ORGANIZATION: Don Mellgren, U.S. Department of Interior, Bureau of Land Management, Denver Federal Center, Denver, CO 80225, (303) 234-2333

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Land Management

FUNDING AMOUNT: \$8,000

DURATION: 10/75 - 11/75 (Completed)

LOCATION: MT

DESCRIPTION: The object of this project is to evaluate the use of tree spade equipment for physically implacing local tree and shrub species on reclaimed lands previously disturbed by coal mining operations. Plant survival and equipment analysis will be made.

PUBLICATIONS: Prepared following transplant operations in November 1975.

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PROJECT TITLE: Use of Organic Soil Amendments in the Revegetation of Surface Mines

INVESTIGATORS/ORGANIZATION: Bland Z. Richardson, Ray Brown, Eugene Farmer, Paul E. Packer, USDA Forest Service, Intermountain Forest and Range Experiment Station, 860 No. 12th East, Logan, UT 84321, (801) 752-1311

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM), and the Intermountain Forest and Range Experiment Station (IF&RES)

FUNDING AMOUNT: FY77 \$2,000 (SEAM), \$2,000 (IF&RES)

DURATION: 7/73 - Continuing

LOCATION: MT, ID

DESCRIPTION: Problem - Virtually all overburden piles in the West contain little or no organic matter and micro-organisms. These soils often puddle and compact resulting in excessive soil bulk densities, low infiltration, and high surface runoff rates. It has been demonstrated that soil micro-organisms play a vital role in the physiological processes of plant growth. Objectives - (1) To determine the influence of various organic soil amendments in the

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physiological responses of plants; (2) To determine the influence of organic soil amendments on the physical-and-chemical properties of overburden materials. Methods - The various organic soil amendments that will be applied in research plots include (1) animal manure, (2) activated sewage sludge, (3) hay and straw, and (4) wood shavings. These amendments will be tilled into the soil and selected grass seed mixtures will be applied. Results - Density and dry-matter production of plant cover will be evaluated in the various treated plots. The influence of these treatments on the chemical and physical properties of soils will be determined using standard testing procedures.

PUBLICATIONS: Contact SEAM, USDA Forest Service, 145 Grand Ave., Billings, MT 59102 for information on publications.

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PROJECT TITLE: Development of a Simulation Model for Evaluating Surface Mining Operations and Reclamation Plans

INVESTIGATOR/ORGANIZATION: David F. Gibson, Dept. of Industrial Engineering, Computer Science, Montana State Univ., Bozeman, MT 59715, (406) 994-3971

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service (U.S. Environmental Protection Agency is providing a portion of the funds for this project)

FUNDING AMOUNT: \$155,000 (FY77 - \$61,000)

DURATION: 1/76 - 6/79

LOCATION: MT, ND, WY (Intermountain area)

DESCRIPTION: The ultimate objective of the study is to provide the land manager with a comprehensive tool for use in evaluating alternative surface coal mine plans. Evaluation would include the examination of proposed mine plans relative to productivity and environmental effects and the resulting trade-offs with respect to mine design. Final output of the study will be a computerized mine planning system. Specific objectives as outlined in the cooperative agreement are: (1) Use existing inventory data on topography, soils, geology, etc. to model the proposed mining site; (2) Develop and use techniques to optimize the location of spoil and topsoil stockpiles using the constraints of material handling capabilities of the equipment and a given reclamation plan; (3) Integrate information on the hydrologic, erodibility, and mass stability characteristics of the spoils and topsoil materials into the optimum location of spoil piles; (4) View cutting plane profiles for any portion of the mined site; (5) Simulate and view (plan view and cutting plane profiles) the results of replacement of spoils and topsoil according to a reclamation plan; and (6) Design a simple, economical system for evaluating mining and land reclamation plans. Data bases and equations (e.g., 1 and 3 above) used in the model will be obtained from results of a companion study.

PUBLICATIONS: David F. Gibson and Thomas E. Lehman. Productivity Improvement of Surface Coal Mining Operations. March 1977. Dept. of Industrial Engineering/Computer Science, Montana State Univ.

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PROJECT TITLE: Acquiring Test Area Imagery (WELUT No. 003.2-76)

INVESTIGATOR/ORGANIZATION: Harp, Ltd., Denver CO

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service,
Western Energy and Land Use Team

FUNDING AMOUNT: \$82,500

DURATION: 6/76 - 8/78

LOCATION: MT (Powder River Basin), ND, WY, CO, NM

DESCRIPTION: This project is designed to acquire imagery at medium scale for the Regional Environmental Test Areas (RETA) by duplicating the existing best one-time Test Area imagery held by various other agency offices, and obtain new aerial photography where coverage for each Test Area does not exist. The acquisition of imagery is a joint effort among the FWS, BLM, and EPA.

PUBLICATIONS: Products - (1) Medium-scale 1:24,000-1:31,680) color infrared imagery. Coverage complete for the following RETAs: Montana/Wyoming, Colorado, Utah, New Mexico. Imagery is not available for distribution but will be used for making maps for public distribution. Contact the Project Officer, Denny Parker, USDI, Fish & Wildlife Service, WELUT, Federal Bldg., Fort Collins, Co. for more information.

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PROJECT TITLE: Alternatives Models for Surface Resources

INVESTIGATORS/ORGANIZATIONS: E.T. Bartlett, D.A. Jameson, 325 Aylesworth Hall,
Colorado State Univ., Fort Collins, CO 80525, (303) 491-5833

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM)

FUNDING AMOUNT: \$45,900

DURATION: 6/74 - 12/75 (Completed)

LOCATION: MT, WY, ND, SD

DESCRIPTION: This project assembled data on surface resources of 63 counties in ND, SD, MT, and WY, into a data bank and utilized a set of analytical procedures which allowed the investigation of alternative land uses to accomplish multiple goals for each of the counties. The resultant product can be used for immediate assessment of the effect of these alternatives on the goals, and can also be used for future evaluations as information and goals change. A multiple-file retrieval system will be utilized to retrieve the information by county designation, ecological response units, mining alternatives, and environmental and economic goals. The data systems used are those already developed by the U.S. Government. An alternative selection procedure known as goal programming was utilized to assemble the information into a form where the multiplicity of interrelated effects are judged in terms of both

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economic and ecological goals. The object of the study was not to make specific recommendations for management of the 63 county area, but to provide a procedure to assist decision makers in determining the effect of various alternatives in terms of achievement toward goals.

PUBLICATIONS: Prototype Model, 9/30/74; Automated Model, 6/30/75; Final Report 9/30/75; Information file and file design, 3/31/75; Tabular data file, 12/31/74; Map data file, 12/31/74.

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PROJECT TITLE: BLM False Color Infrared and Interpretation Mapping Study

INVESTIGATOR/ORGANIZATION: Robert E. Carroll, Ecological Consulting Service, 1300 Cedar, Helena, MT 59601, (406) 442-4650

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Land Management

DURATION: 1/77 - 5/77 (Completed) LOCATION: MT - Wibaux Plan. Unit.

DESCRIPTION: False color infrared and interpretation mapping for current land use range terrestrial ecosystems, aquatic ecosystems, scoria outcrops, erosion class and condition and various other parameters for the U.S. Bureau of Land Management.

PUBLICATIONS: Numerous maps and an interpretative report were submitted to the U.S. Department of the Interior, Bureau of Land Management.

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PROJECT TITLE: Color Infrared Aerial Photography -- Montana, North Dakota, and Wyoming -- Areas Subject to Energy Development

INVESTIGATORS/ORGANIZATIONS: Fred Batson, USDI Bureau of Land Management, Federal Bldg., 316 N. 26th St., Billings, MT 59101; (contractor) Mark Hurd Aerial Surveys, Inc., Minneapolis, MN

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service; U.S. Department of the Interior, Bureau of Land Management

FUNDING AMOUNT: \$122,000 (FWS); \$16,000 (BLM)

DURATION: 5/75 - 10/75 (Completed)

LOCATION: MT (Dawson, Richland, Wibaux, McCone, Carter, Custer, Roosevelt, and Sheridan Counties), ND, WY

DESCRIPTION: The FWS and the BLM entered a cooperative agreement whereby the FWS provided the bulk of funds and the BLM provided contracting services for acquisition of 27,000 square miles of 1:80,000 color infrared photography and 970 lineal miles of 1:24,000 CIR photography. All of the 1:80,000 photography is quad-centered; every other frame corresponds to the USGS 7 1/2 minute quad

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maps. A duplicate of this photography will be stored at the EROS Data Center, Sioux Falls, SD, and is available to the public for purchase of copies. The 1:24,000 scale photography covers the Missouri River between Garrison Dam and Oahe Reservoir in ND and between Marony Dam and Ft. Peck Dam in MT. It also covers the Bighorn River downstream from Hardin, MT. This is considered project imagery.

PUBLICATIONS: For availability of the photography, contact the primary sponsor, US FWS, P.O. Box 25486, Denver Federal Center, Denver, CO 80225.

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PROJECT TITLE: Current Land Use Mapping and Contour Mapping of 30 Square Miles at Glasgow Air Force Base

INVESTIGATOR/ORGANIZATION: Robert E. Carroll, Ecological Consulting Service, 1300 Cedar, Helena, MT 59601, (406) 442-4650

FUNDING AGENCY: Montana College of Mineral Sciences and Technology Foundation, Butte, MT

FUNDING AMOUNT: \$5,000

DURATION: 5/75 - 5/75 (Completed)

LOCATION: MT - Valley Co. (30 square mile area including Glasgow Air Force Base)

DESCRIPTION: From 1:80,000 scale quad-centered false color infrared film, produce four 1:24,000 rectified black and white photo quads corresponding to 7 1/2 minute USGS topographic contours of a 30-square mile area including Glasgow Air Force Base, produce a current land use overlay at 1:12,000 scale by interpreting air and obtaining ground truth, to be used as map base for energy park feasibility studies of Glasgow AFB.

PUBLICATIONS: See above.

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PROJECT TITLE: Evaluation of CIR Imagery Analysis Techniques (WELUT No. 004.3-76)

INVESTIGATOR/ORGANIZATION: Jack Sparks, HRB Singer, Inc. P.O. Box 60, State College, PA 16801

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Western Energy and Land Use Team

FUNDING AMOUNT: \$245,100

DURATION: 9/76 - 3/78

LOCATION: MT, WY

DESCRIPTION: This study will evaluate and compare manual and machine-aided analog and digital processing of CIR imagery for extracting detailed ecological and land-use information. Tests will be conducted to determine the capability of medium-scale CIR imagery to delineate the distribution of and inventory the amount of land in certain ecological and land-use classes. The capability of large-scale CIR imagery to provide quantitative estimates of species composition, frequency, and density of vegetation will also be investigated. The study will provide estimates of unit cost, time requirements and accuracy for each of the tested methods.

PUBLICATIONS: Products will include (1) Maps illustrating vegetation subclass and land-use classes and subclasses, and the accuracy associated with each; (2) Operationally oriented report documenting the methods, approach, unit cost estimates, time requirements, accuracy estimates, advantages and disadvantages of manual and machine-aided analog and digital processing of CIR imagery. Copies are now available of H.R.B. Singer, Inc. Technical Literature Review. May 1977. (WELUT-77/10). Available from Project Officer, Denny Parker, US FWS, WELUT, Federal Center, Fort Collins, CO 80521.

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PROJECT TITLE: Existing Test Area Imagery (WELUT No. 003.1-76)

INVESTIGATOR/ORGANIZATION: Photo Sciences, Inc., 7840 Airpark Rd., Gaithersburg, MD 20760

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Western Energy and Land Use Team

FUNDING AMOUNT: \$32,315

DURATION: 5/76 - 4/77 (Completed)

LOCATION: MT (Part of Crow Reservation and Powder River Co.), ND, WY, CO, UT, NM

DESCRIPTION: Existing suborbital remote-sensing imagery covering five Regional Environmental Test Areas will be located, identified, indexed, duplicated, and maintained for FWS uses. By cataloging the imagery that exists for the Western U.S., the project identified coverage that is lacking in the test areas.

PUBLICATIONS: (1) Tabular index of all imagery (from 1:3,000 to 1:130,000) including a description of the imagery, its location, availability, contact

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points, etc. (2) Index maps and overlays (scale 1:250,000) showing aerial photography and skylab satellite coverage for each of the five Regional Environmental Test Areas (WELUT 77/05). Copies of the tabular index and index maps are not available for distribution but may be viewed by appointment at the US FWS, Billings Area Office or the Ft. Collins Office of Biological Services, WELUT. For more information contact the Project Officer, Denny Parker.

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PROJECT TITLE: Grassland and Shrubland Plant Community Classification in Eastern Montana

INVESTIGATOR/ORGANIZATION: John E. Taylor, Dept. of Animal and Range Sciences, Montana State Univ., Bozeman, MT 59715, (406) 994-3721

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM)

FUNDING AMOUNT: \$30,000

DURATION: 3/75 - 12/75 (Completed)

LOCATION: MT - Rosebud and Powder River Counties

DESCRIPTION: A classification system was developed, using 10 "ecosystems" based on topographic and vegetational criteria. The Division was then mapped on this basis. Supporting data on soils and phenology were then collected, and are being analyzed as part of an MS project.

PUBLICATIONS: The U.S. Forest Service (Custer National Forest, Billings) has reproduced small numbers of the final report, but they are available only for examination because of their length.

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PROJECT TITLE: Habitat Classification Systems (WELUT No. 004.1-76)

INVESTIGATOR/ORGANIZATION: Ecology Consultants, Inc., 1716 Heath Parkway, Fort Collins, CO 80521

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

FUNDING AMOUNT: \$23,578

DURATION: 9/76 - 1/77 (Completed)

LOCATION: Western States

DESCRIPTION: The study compiled a list and associated descriptions of all land use and vegetation classification systems in use by federal and state land and resource management and planning agencies in the Western U.S. and evaluated each system. The project encompassed the states of ND, SD, NE, KS, TX, NM, CO, WY, MT, ID, UT, NV, AZ, CA, OR, WA, and AK. It included all state agencies, and state and regional offices of federal agencies involved in renewable resource management, planning, and research.

PUBLICATIONS: S. Ellis, C. Fallat, N. Reece, and C. Riordan. Guide to Land Cover and Use Classification Systems Employed by Western Governmental Agencies.

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Ecology Consultants, Inc. Fort Collins, CO. March 1977. (FWS/OBS-77/05).
NTIS Accn. No. PB 265 173/AS (PC:A09/MF:A01).

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PROJECT TITLE: Inventory of Land Surfaces Mined Prior to 1976 in the Western United States and Their Reclamation History (WELUT No. 020.1-77)

INVESTIGATOR/ORGANIZATION: Melvin Schamberger, NALCO Environmental Sciences, 6216 W. 66th Place, Northbrook, IL 60638

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Office of Biological Services, Western Energy and Land Use Team

FUNDING AMOUNT: \$54,800

DURATION: 12/76 - 12/77

LOCATION: Western U.S. (ND, SD, MT, WY, CO, UT, NM, NV, ID, CA, WA, AZ)

DESCRIPTION: The project will produce an atlas of land surfaces mined between 1900 and 1976 in the Western U.S. The atlas will include maps and supplemental information on location, ownership, type of mining and its history, type of reclamation effort, and special characteristics of either the mining or post-disturbance activity of each mine. All available sources of information (e.g., government records, mining company records, and other published sources) that identify and describe surface-mined land areas greater than 10 acres in the Western U.S. and North and South Dakota (13 subject states) will be examined, only coal, phosphate, and uranium mines will be included in this search.

PUBLICATIONS: An atlas of land surfaces mined between 1900 and 1976 will be prepared. The atlas will present maps, by state, of the disturbed sites together with the narrative and tabular data. The atlas will be cross-indexed and shall include orphaned lands, reclaimed lands, acreage-size classes, vegetation types, mining operators, mining methods, products extracted, and other appropriate subjects. The maps shall be produced on mylar overlays and be of sufficient size (approximately 1:1,000,000) and detail to allow a person unfamiliar with the area to locate the approximate area of the strip-mining disturbance and, with the aid of other information contained in the atlas, locate the mined area. Contact the Project Officer, John Morrison, WELUT, USFWS, Federal Bldg., Fort Collins, CO 80521 for availability.

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PROJECT TITLE: Natural Resources Inventory

INVESTIGATOR/ORGANIZATION: Robert E. Carroll, Ecological Consulting Service, 1300 Cedar, Helena, MT 59601 (406) 442-4650

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Land Management

FUNDING AMOUNT: \$32,000

DURATION: 5/74 - 12/74 (Completed)

LOCATION: MT - South Rosebud and Coalwood Planning Units (3000 sq. miles)

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DESCRIPTION: Obtain and interpret high altitude 1:80,000 scale quadcentered false color infrared and obtain ground truth to delineate and map: (1) vegetation habitat types; (2) wildlife habitat; (3) scoria (procelanite); (4) erosion susceptibility; (5) erosion class and condition; (6) range condition; (7) current land use.

PUBLICATIONS: Final report to U.S. Dept. of Interior, Bureau of Land Management

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PROJECT TITLE: Remote Sensing Especially Designed for Revegetation of Areas Disturbed by Surface Mining

INVESTIGATOR/ORGANIZATION: Inge Dirmhirn, Utah State Univ, Logan, UT; Paul E. Packer, Bland Z. Richardson, USDA Forest Service, Intermountain Forest and Range Experiment Station, 860 N. 12th East, Logan, UT 84321, (301) 752-1311

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM)

FUNDING AMOUNT: \$16,000

DURATION: 6/74 - 10/74 (Completed)

LOCATION: MT - Big Horn Co. (Decker), UT (Cobalt)

DESCRIPTION: Problem - As surface mining accelerates to meet rapidly increasing energy needs, both government and industry will be required to insure that essential minerals can be extracted with a minimum of harm to the environment. The objectives of this project are: (1) To determine the surface temperature of areas disturbed by mining activities, particularly with respect to their extremes; (2) To make an aerial inventory of pertinent ground characteristics of the area by color and IR photography; (3) To provide the necessary ground truth measurements for the airborne techniques; (4) To combine these techniques to provide a classification of ground areas; (5) To make necessary ground measurements of unfavorable (and less favorable) areas to determine microsituations where growth could be started despite the overall mesoscale negative conditions.

PUBLICATIONS: Final Report, October 1974.

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PROJECT TITLE: Remote Sensing of Resource Data on Southeastern Montana Rangelands

INVESTIGATOR/ORGANIZATION: John E. Taylor, Dept. of Animal and Range Sciences, Montana State Univ., Bozeman, MT 59715, (406) 994-3721

FUNDING AGENCY: U.S. National Science Foundation, RANN

FUNDING AMOUNT: \$42,017

DURATION: 5/75 - 10/76 (Completed)

LOCATION: Southeastern MT

DESCRIPTION: The scope of this project may be discerned in the project objectives

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which are: (1) To assemble files of both currently available and new remote imagery of representative ecosystems in the areas of southeastern Montana subject to strip mining and power generating plants; (2) To establish benchmark data banks of ground truth, image interpretation, maps, and historic records of natural and disturbed ecosystems; (3) To monitor any land use changes and any uncontrolled disturbances which may occur due to strip mining and related activities; (4) To provide a variety of remote sensing and ground truth data on vegetation, soils, surface disruption, erosion, and other pertinent variables to scientists working on related projects. (NOTE: This study is a sub-project of The Impact of Coal Development in the Fort Union Basin, Montana and Neighboring States, Project No. 141.)

PUBLICATIONS: Final report to National Science Foundation, RANN program.

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PROJECT TITLE: Remote Sensing Resources Project

INVESTIGATORS/ORGANIZATION: Scott Fisher, Larry Reddin, Mt. Dept. of Natural Resources and Conservation, 32 South Ewing, Helena, MT 59601, (406) 449-3780

FUNDING AGENCY: U.S. National Aeronautics and Space Administration, and the Federation of Rocky Mountain States

FUNDING AMOUNT: \$10,500

DURATION: 4/75 - 11/76 (Completed)

LOCATION: MT

DESCRIPTION: The objects are - (1) To provide base data on land use, soils, plant communities, physiography, and geology from known locations in the project area which will serve as an informational base for computer mapping by Colorado State University using ERTS tapes; (2) To test this type of inventory analysis for potential use as an initial resource gathering procedure for use in the EPD corridor selection methodology. The study area includes the area between 106°-107° W. and 45°-46° N. The color infrared photography for this area is at a scale of 1:125,000.

PUBLICATIONS: Landsat Study. November 1976. Federation of Rocky Mountain States.

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PROJECT TITLE: Trend-Surface Analysis of Powder River Basin, Wyoming, Wyoming-Montana, and Williston Basin, North Dakota

INVESTIGATORS/ORGANIZATION: Teruo Yamamoto, Ardell J. Bjugstad, USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Forestry Research Lab., SD School of Mines Campus, Rapid City, SD 57701, (605) 343-0811

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM)

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FUNDING AMOUNT: Approx. \$15,075

DURATION: 6/74 - 9/78

LOCATION: MT, WY, ND

DESCRIPTION: Objectives: (1) Quantify selected topographic parameters from topographic maps; (2) Produce a topographic isopleth (equal value line) map of study area; (3) Determine significant topographic distinctiveness or variations existing in study area; (4) Associate topographic trends to geomorphologic processes and derive geohydrologic implications related to disruption of topography; and (5) To provide baseline interpretations applicable to landscape design compatible with adjoining undisturbed areas. Methods and Location - Landform parameters will be measured on USGS topographic maps for the Powder River Basin area in northeastern Wyoming and southeastern Montana. The raw map data are then converted to trend maps by computer graphics. The trends are mathematically computed planes or gently curving surfaces fitted by the least squares method.

PUBLICATIONS: Teruo Yamamoto. 1975. Trend Surface Analysis of Powder River Basin, Wyoming-Montana. In Proc. Fort Union Coal Field Symp. Vol. 3: Reclamation Section, p. 280-288. (Mont. Acad. Sci., Billings, Apr. 1975)

COAL

1.8 POLICY STUDIES

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PROJECT TITLE: Energy Regulation and Technological Change (NSF 74-07918 A01)

INVESTIGATORS/ORGANIZATION: Richard Nehring, Fred Hoffman, Ben Zycher, Joe Wharton, The Rand Corporation, 1700 Main Street, Santa Monica, CA 90406 (213) 393-0411

FUNDING AGENCIES: U.S. National Science Foundation; The Rand Corporation

FUNDING AMOUNT: \$65,000 (NSF); Approx. \$70,000 (RAND)

DURATION: 11/73 - 8/76 (Completed) LOCATION: MT, WY, ND (No. Great Plains)

DESCRIPTION: This study was designed to (1) Provide a basic framework for understanding the interaction between major energy supply innovations and government regulation; (2) Describe the characteristics and development of the No. Great Plains coal resource; (3) Describe the adverse effects of coal development and existing federal and state regulation affecting them; and (4) To define possible state and federal regulatory roles in Northern Great Plains coal development.

PUBLICATIONS: R. Nehring, B. Zycher, J. Wharton. Coal Development and Government Regulation in the Northern Great Plains: A Preliminary Report. August 1976. Prepared in part under a grant from NSF (R-1981-NSF/RC. Available from The Rand Corporation, Santa Monica, CA 94006.

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PROJECT TITLE. Evaluate the Process and Constraints of Federal Land Use Planning in Energy Impacted Areas

INVESTIGATOR/ORGANIZATION: Stephen James, Woodward-Clyde Associates, 600 Montgomery Street, San Francisco, CA 94111

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$27,265

DURATION: 1/76 - 3/78

LOCATION: MT - Decker Birney Planning Unit, Custer National Forest

DESCRIPTION: (1) A review of the land-use plan developed by the USDI, Bureau of Land Management and the USDA Forest Service, in cooperation with the State of Montana, for the Decker-Birney Planning Unit; (2) Evaluation and documentation of the degree of compatibility and consistency of land-use guidelines with Federal/State environmental legislation and regulations; (3) Analysis of the multi-jurisdictional situation and constraints; (4) Documentation of the process of guideline implementation; (5) Identification of the mechanisms available to enforce guidelines implementation policies to ensure the maintenance or enhancement of environmental quality; (6) Where and if necessary, development of recommendations to improve the guidelines and implementation policies to insure the maintenance or enhancement or environmental quality; (7) Recommendation of a system to monitor the environmental impacts including socio-economic aspects of plan implementation.

PUBLICATIONS: Final report in review. Available in early 1978.

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PROJECT TITLE: Fort Union Regional Task Forces

INVESTIGATOR/ORGANIZATION: Sheila Miedema, North Dakota Legislative Council, Capitol Building, Bismarck, ND 58501

FUNDING AGENCY: Partial support from the U.S. National Science Foundation, Division of Intergovernmental Science and Public Technology; ND Legislative Council

FUNDING AMOUNT: \$111,000 (Phase II) DURATION: 4/76 - 4/77 (Completed)

LOCATION: MT, WY, ND, SD

DESCRIPTION: With partial support from the U.S. National Science Foundation, the four states of North Dakota, South Dakota, Montana and Wyoming, created seven task forces to study the interstate effects of the development of the Fort Union Coal Formation which underlies parts of each of these states. The task forces included key legislators, executive branch personnel, academicians, representatives of Indian tribal nations, and citizens representing the general public of each state. Topics of common concern facing the groups included air quality, water quality, water allocation, plant siting, energy development, reclamation, taxation, and social and economic impact. The task forces examined methods to assist member states in problem solving as well as acquainting the members with the energy development positions and accompanying laws and regulations of their sister states. Federal and regional information sources are used to obtain current energy-environmental data. These task forces served to provide each members state with the information and materials necessary for sound policy decisions relative to energy-environmental issues during the 1977 Legislative Sessions.

PUBLICATIONS: Fort Union Regional Task Forces, Proceedings, Vol I and II, December 1976. Also, Fort Union Regional Task Forces Legislative Handbook on Energy-Related Topics, December 1976.

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PROJECT TITLE: Projections of Mt. Coal Mining and Energy Conversion Development

INVESTIGATOR/ORGANIZATION: Arnold J. Silverman, Thomas M. Power, University of Montana, Missoula, MT 59801; Richard Stroup, Montana State Univ., Bozeman, MT

FUNDING AGENCY: U.S. National Science Foundation, RANN

FUNDING AMOUNT: \$37,020 DURATION: 5/75 - 4/76 (Completed)

LOCATION: MT, WY, ND (Northern Great Plains)

DESCRIPTION: This study projects the probable levels of coal development in Montana and adjacent Northern Great Plains states in the next five, ten, and twenty-five years. The Coal Demand Study attempts to do three things: (1) Present a systematic way to evaluate what will influence NGP coal development; (2) Indicate the key "swing" variables determining development; and (3) Establish how, quantitatively, the level of development will vary if these variables change. Two primary sources of demand for NGP coal are analyzed -- coal-fired electric generation and gasification of coal into synthetic natural gas.

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A detailed comparison was made of the Coal Demand Study results with other projections of NGP coal development, principally the Northern Great Plains Resources Program's National and Regional Energy Considerations Work Group Report and the Federal Energy Administration's Project Independence Report. (NOTE: This study is a sub-project of The Impact of Coal Development in the Fort Union Basin, Montana and Neighboring States, Project No. 141.)

PUBLICATIONS: Projections of Northern Great Plains Coal Mining and Energy Conversion Development 1975-2000, Final Report, May 1976. Montana University Coal Demand Study Team. (NSF/RANN No. AER 75-14178).

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PROJECT TITLE: Northern Great Plains Resources Program

INVESTIGATOR/ORGANIZATION: John G. VanDerwalker, Program Manager, Northern Great Plains Resources Program 820B, Bldg. 67, Denver Federal Center, Denver, CO 80225

FUNDING AGENCIES: Joint effort by U.S. Department of the Interior, U.S. Department of Agriculture, U.S. Environmental Protection Agency; also the state governments of MT, NE, WY, ND, SD

DURATION: 1971 - 4/75 (Completed)

LOCATION: MT, WY, NE, SD, ND (Northern Great Plains)

DESCRIPTION: The Northern Great Plains Resources Program (NGPRP) was organized in 1971 to provide information and a comprehensive analysis that will place in perspective the potential impacts of coal development and thereby assist the people of the NGP and the Nation to wisely manage the natural and human resources of this region. The reported studies and investigations were made by seven work groups, whose specific subject areas were: Regional Geology, Mineral Resources, Water, Atmospheric Aspects, Surface Resources, Social, Economic, and Cultural Aspects, and National Energy Considerations. Analyses of the effects of different rates of coal development are based on three pre-designated "CDP's" (Coal Development Profiles). CDP-I is for a "low" level of development; CDP-II, "intermediate"; and CDP-III, "high." Each profile is analyzed in three time frames - 1980, 1985, and 2000. The study was directed toward a better understanding of the issues associated with coal development in the No. Great Plains so that critical assessments and decisions are facilitated.

PUBLICATIONS: Effects of Coal Development in the Northern Great Plains -- A Review of Major Issues and Consequences at Different Rates of Development. April 1975. This report is a summary of information received from seven Work Groups. The individual reports of the Work Groups are deposited in the major libraries of the five-state region considered in the study.

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PROJECT TITLE: Resource Taxation, Tax Exportation and Regional Energy Policies

INVESTIGATORS/ORGANIZATION: Robert Shelton, William Morgan, Institute for Policy Research and Department of Economics, University of Wyoming, Laramie, WY 82071 (307) 766-5141

FUNDING AGENCY: Univ. of Wyoming (in-house project)

DURATION: 6/76 - 1/77 (Completed)

LOCATION: MT, WY, AZ, CO, NM, UT

DESCRIPTION: The purpose of this study was to analyze energy policies and natural resource taxation for the states in the Rocky Mountain Region. The study made specific reference to coal, since the current and potential future coal situation in the region provided an excellent case for the examination of alternative state economic objectives and provided a basis for the analysis of various public policies that could be used to attain the objectives. The study focused on taxation rather than public expenditure policies as the primary means of attaining state objectives. The rationale for coal severance taxes was analyzed assuming alternative objectives for the states in the Rocky Mountain Region and taking into account the states' different demand and supply conditions. One important issue that was considered is whether the states should harmonize coal severance taxation.

PUBLICATIONS: (1) Robert B. Shelton, William E. Morgan. Resource Taxation, Tax Exportation, and Regional Energy Policies. Research Paper No. 137, Dept. of Economics, University of Wyoming, Laramie, WY 82071. (2) William E. Morgan and Robert B. Shelton. Natural Resource Taxation, Tax Exportation and the Stability of Fiscal Federalism. Research Paper, No. 114, Department of Economics. August 1976.

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PROJECT TITLE: Yellowstone Basin and Adjacent Coal Area Level B Study -- Energy Analyses

INVESTIGATOR/ORGANIZATION: Jerry Knapp, Harza Engineering Company, 150 So. Wacker Drive, Chicago, IL 60606, (312) 855-7000

FUNDING AGENCY: U.S. Water Resources Council, Missouri River Basin Commission

FUNDING AMOUNT: \$105,000

DURATION: 1/76 - 12/76 (Completed)

LOCATION: MT, WY, ND (Yellowstone River Basin)

DESCRIPTION: The consultant accomplished an economic evaluation of future energy supplies and demands and projected regional participation in the energy market based on a low, most probable, and high regional energy development scenario. From these projections, economically consistent in-basin synthetic fuels and thermal electric power plants and transportation networks were predicted recognizing water and air quality standards, reclamation requirements, and other environmental factors and social implications. Two models were developed: a macro model to site plants and transportation facilities recognizing local conditions and constraints. The models may be used to answer "what if" questions concerning

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shifts in any of the factors relating to regional participation in the national energy picture. (NOTE: This study is a sub-project of Yellowstone Basin and Adjacent Coal Area Level B Study: Montana, Wyoming, North Dakota, Project No. 414.)

PUBLICATIONS: (1) Analysis of Energy Projections and Implications for Resource Requirements. December 1976. Harza Engineering Co. Prepared for the Missouri River Basin Commission. (2) Water for Energy in the Yellowstone River Basin and Adjacent Coal Areas. (Paper presented at the 12th American Water Resources Conference, Chicago, September 1976.)

COAL

1.9 SOCIAL AND ECONOMIC STUDIES

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PROJECT TITLE: Assessment of Temporary and Mobile Public Facilities for Impacted Communities

INVESTIGATOR/ORGANIZATION: James H. Silverthorn, Howard, Needles, Tammen and Bergendoff, P.O. Box 3101, Casper, WY 82601

FUNDING AGENCY: Old West Regional Commission FUNDING AMOUNT: \$45,142

DURATION: 7/75 - 7/76 (Completed) LOCATION: MT, ND, SD, NE, WY

DESCRIPTION: The purpose of the project is to identify the state of the art of temporary and mobile public facilities, to assess the performance and overall feasibility of such facilities for communities and construction projects in the Old West Region, and to assess the feasibility of a pool of mobile facilities moving from one construction site to another. In addition to the above objectives, standards and guidelines for mobile and temporary public facilities will also be recommended. The types of public facilities to be considered will include educational, library, medical, sewer, water, recreational, housing and semipublic.

PUBLICATIONS: Temporary/Mobile Facilities for Impacted Communities. July 1976. Howard, Needles, Tammen and Bergendoff.

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PROJECT TITLE: Assistance from Energy Developers: A Negotiating Guide for Small Communities

INVESTIGATORS/ORGANIZATION: Michael Frankel, Isabel Reiff, Centaur Management Consultants, Inc., 1120 Connecticut Avenue NW, Washington, D.C. 20036 (202) 296-4100

FUNDING AGENCY: U.S. Energy Research and Development Administration, Office of Planning Analysis and Evaluation

DURATION: 1/77 - 7/77 (Completed) LOCATION: Nationwide

DESCRIPTION: The purpose of this report is to provide guidance to small communities on negotiating for assistance from energy developers. The report places the negotiating strategy into the context of a total program at the local level of assistance from numerous sources. A case study illustrates one method of determining fiscal implications of development which may be the impetus for the negotiations.

PUBLICATIONS: Assistance From Energy Developers: A Negotiating Guide for Small Communities. Final Report to ERDA, Centaur Management Consultants.

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PROJECT TITLE: Bridging Resource and Social Variables: A Project to Learn How to Plan for and Manage "People Problems" Associated with Mineral and Other Resource-Related Development

INVESTIGATOR/ORGANIZATION: Raymond L. Gold, Institute for Social Research,

COAL/Social and Economic Studies

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University of Montana, Missoula, MT 59812, (406) 243-5411

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program (SEAM)

FUNDING AMOUNT: FY77 \$70,000; Prior \$18,000

DURATION: 9/75 - 1/78

LOCATION: MT and Northern Region of the Forest Service

DESCRIPTION: The Forest Service is concerned with the potential for social impact upon forest and rangeland users and associated communities in the State of Montana and the Northern Region of the Forest Service and the Western United States from a variety of land uses such as mineral development, timber harvest, wilderness use and recreation. There are currently very few viable processes for assessing and taking into account such impact. The University is currently conducting studies designed to evaluate social impact methods, make Social Impact Assessment, and determine practical application techniques for decision-makers to properly take them into account. Since several State and Federal agencies are also interested in Social Impact Assessment and application processes and methods, it is in their interest to work jointly in applying such methods and processes. Objectives: (1) To understand social science principles which pertain to the basic values and value changes of people in this part of the U.S. (2) To achieve a working ability to apply basic social science principles to the work of the agency; (3) To relate the social to the physical and biological; (4) To develop agency and functionary roles for dealing with the social; (5) To foster coordination of interagency roles for dealing with the social.

PUBLICATIONS: Raymond L. Gold. Final Report Draft -- Bridging Resource and Social Variables: A Project to Learn How to Plan for and Management "People Problems" Associated with Mineral and Other Resource-Related Development. January 5, 1978.

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PROJECT TITLE: Community Assistance Project

INVESTIGATOR/ORGANIZATION: William Lamont, Briscoe, Maphis, Murray and Lamont, Inc., 2336 Pearl Street, Boulder, CO 80302, (303) 449-8668

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$51,043 (FY77 \$9,399)

DURATION: 2/76 - 8/77 (Completed)

LOCATION: Rocky Mountain Region (Case studies in Scobey, MT, and Sheridan, WY)

DESCRIPTION: The general objective is to develop an action document for rural communities and counties which address problems associated with the economic, environmental, physical, and financial problems that would result from development of energy and mineral resources in the Rocky Mountain Region. There are two case studies -- Scobey, Montana, and Sheridan, Wyoming.

PUBLICATIONS: (1) Action Handbook for Energy Impacted Rural Communities (will be available in June 1978); (2) Case study application writeups for Scobey, MT and Sheridan, WY. These have been completed.

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PROJECT TITLE: Comparable Situations Analysis of the Missouri Basin Power Project

INVESTIGATOR/ORGANIZATION: Roger L. Hayen, Div. of Business and Economic Research, University of Wyoming, P.O. Box 3925, University Station, Laramie, WY 82071, (307) 766-5141

FUNDING AGENCIES: Basin Electric Power Coop, Bismarck, ND; Missouri Basin Power Project, Cheyenne, WY

FUNDING AMOUNT: \$8,666

DURATION: 8/74 - 3/75 (Completed)

LOCATION: MT, WY, SD, ND, CO, AZ

DESCRIPTION: A qualitative analysis of socioeconomic impact resulting from the construction of coal-fired electrical generating plants at eight locations in the Rocky Mountain Region. Data was gathered through personal interviews with key community leaders and recorded in the form of trip reports.

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PROJECT TITLE: A Comparative Case Study of the Impact of Coal Development on the Way of Life of People in the Coal Areas of Eastern Montana and Northeastern Wyoming

INVESTIGATOR/ORGANIZATION: Raymond L. Gold, Institute for Social Research, University of Montana, Missoula, MT 59801, (406) 243-5411

FUNDING AGENCY: U.S. Department of the Interior, Northern Great Plains Resources Program

FUNDING AMOUNT: \$57,875

DURATION: 8/73 - 6/74 (Completed)

LOCATION: Eastern MT, Northeastern WY

DESCRIPTION: The purpose of this ethnographic study was to present the views, thoughts, feelings, and reactions of people living in the coal areas of eastern Montana and northeastern Wyoming regarding the impact which coal development is having on these residents way of life. Results of the qualitative research is of assistance to those who are involved in decisions about energy resources which will so fatefully affect this part of the nation, those who are charged with planning for and dealing with the social costs of these decisions, and those whose lives and life-styles are changing as a result of coal-related industrial growth and development.

PUBLICATIONS: Raymond L. Gold. A Comparative Case Study of the Impact of Coal Development on the Way of Life of People in the Coal Areas of Eastern Montana and Northeastern Wyoming, Final Report, June 30, 1974.

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PROJECT TITLE: Compilation of Raw Data on Energy-Impacted Communities

INVESTIGATORS/ORGANIZATION: Polly Garrett, Candis Webb, U.S. Federal Energy Office, P.O. Box 20247, 1075 So. Yukon, Lakewood, CO 80226, (303) 234-2596

FUNDING AGENCY: U.S. Federal Energy Administration (in house project)

DURATION: 12/75 - Continuing

LOCATION: Energy impacted communities in MT, WY, CO, ND, SD, UT

DESCRIPTION. This annual Federal Regional Council compilation lists communities in CO, MT, ND, SD, UT, and WY that are being, or expect to be impacted by energy development. Socio-economic data is developed in cooperation with states and included in the annual report. This data includes housing, schools, population, health facilities, planning assistance and growth related problems.

PUBLICATIONS: Compilation of Raw Data on Energy Impacted Communities, Including Characteristics, Conditions, Resources, and Structures for Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming. June 1976. Mountain Plains Federal Regional Council, 1961 Stout Street, Room 14037, Denver, CO 80294.

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PROJECT TITLE: Comprehensive Analysis of Issues Regarding Energy Resource Development on Indian Reservations (FEA CR-04-60921-00)

INVESTIGATOR/ORGANIZATION: Lawrence H. Revzan, Ernst and Ernst, 1225 Connecticut Avenue, NW, Washington, D.C. 20036, (202) 296-8300

FUNDING AGENCY: U.S. Federal Energy Administration

FUNDING AMOUNT: \$341,834 (FY77 \$228,452)

DURATION: 10/76 - 1/78

LOCATION: MT, AZ, CO, NM, UT, WY, ND, SD, OK

DESCRIPTION: Objectives - Conduct an analysis of financial, social, and economic aspects of development of energy resources on Indian lands -- 22 designated energy resource tribes. Five major study tasks: (1) Economic and financial analysis; (2) Management analysis; (3) Assessment of education and training requirements; (4) Program plan for Indian energy clearinghouse; (5) Environmental impact analysis. With respect to each task: (1) Determine feasibility; (2) Develop implementation options; (3) Provide alternative recommendations as required; (4) Conduct cost analysis for implementation of options and/or alternatives. The energy resource tribes in Montana are: Crow, Blackfeet, Fort Belknap, Fort Peck, Northern Cheyenne. Four workshops will be held in the Fall of 1977. Representatives of the participating tribes will be invited to one of the workshops.

PUBLICATIONS: A five-volume draft final report has been submitted and is now undergoing review by the FEA. Final draft report should be ready in late 1977. Final report will be available through NTIS.

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PROJECT TITLE: Construction Worker Profile

INVESTIGATORS/ORGANIZATION: James A. Chalmers, Judith Glazner, Mountain West Research Inc., 280 Columbine Street, Suite 301, Denver, CO 80206

FUNDING AGENCY: Old West Regional Commission

FUNDING AMOUNT: \$74,974

DURATION: 2/75 - 11/75 (Completed)

LOCATION: MT, ND, WY, UT, AZ, CO

DESCRIPTION: The Construction Worker Profile was conducted for the Old West Regional Commission to study the socio-economic consequences of the construction of large energy-related facilities. The emphasis of the study was on the collection of primary data, and three distinct efforts were required. A household survey was conducted which consisted of door-to-door interviews with 1,432 households in nine western communities which have been affected, are being affected, or will be affected by large energy-related construction projects. The purpose of the household survey was to determine household and labor force characteristics, commuting patterns, residential preferences, social integration, household expenditures, satisfaction with community services, and attitudes of residents about both the projects and their community. Respondents to the household survey include residents who lived in the community prior to the construction projects and, in the case of currently affected communities, newcomer construction workers and other newcomers. For the post-impact communities, a sample of all residents was interviewed. A project survey was undertaken which consisted of distributing and collecting short self-administered questionnaires to construction workers at 14 major construction sites in eight western states. A total of 3168 responses were obtained which indicate workers' characteristics with respect to household composition, place of residence, previous residence, and occupation. A community survey during which three social scientists lived for a time in three of the household survey communities, and conducted structured, in-depth interviews with households and less structured interviews with institutional representatives was the third activity of the study. The purpose of this procedure was to determine some of the construction period impacts on the personal lives of community residents and on the communities' institutions, and also to observe both individual and institutional response to those impacts.

PUBLICATIONS: The results of the study are summarized in 10 documents: (1) Construction Worker Profile: Final Report; (2) Construction Worker Profile: Summary Report; (3) Construction Worker Profile: Community Reports -- Green River and Rock Springs, WY, Forsyth and Colstrip, MT, Center, ND, Langdon, ND, Conrad, MT, Killdeer, ND, St. George UT; (4) Construction Worker Profile: User's Guide to the Data. Available on request from: Old West Regional Commission, 1730 "K" Street, NW, Suite 426, Washington, D.C. 20006.

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PROJECT TITLE: Decker-Birney Socio-Economic Study

INVESTIGATOR/ORGANIZATION: Patrick C. Jobes, Department of Sociology, Montana State University, Bozeman, MT 59715, (406) 994-4201

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Land Management (through the Montana Energy Advisory Council)

FUNDING AMOUNT: \$26,010

DURATION: 7/74 - 4/75 (Completed)

LOCATION: MT - Big Horn, Powder River, and Rosebud Counties

DESCRIPTION: The purpose of this study was to identify attitudinal predelictions and to develop a description of environmental orientations held by residents of the three counties of Eastern Montana (Big Horn, Powder River, and Rosebud) that will be affected if strip mining of federally owned coal is allowed in the Decker-Birney Area. The descriptions will aid in better understanding the philosophical motivations of residents as they wrestle with the pros and cons of coal development and help develop better public education strategies centered around energy issues.

PUBLICATIONS: Patrick C. Jobes and Milton G. Parsons. Satisfaction, Coal Development and Land Use Planning: A Report of Attitudes Held by Residents of the Decker-Birney Study Area. Submitted to the Montana Energy Advisory Council, April 1975.

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PROJECT TITLE: The Decker Mine Proposals: A Demographic Analysis

INVESTIGATOR/ORGANIZATION: John Fitzpatrick, Office of Budget and Program Planning, State Capitol, Helena, MT 59601

FUNDING AGENCY: Partly funded by a Decker Coal Company grant to the Mt. Dept. of State Lands for the Decker EIS.

FUNDING AMOUNT: Approx. \$8,000 DURATION: 7/75 - 3/76 (Completed)

LOCATION: MT - Rosebud and Big Horn Counties; WY - Sheridan County

DESCRIPTION: To outline a maximum boundary for the demographic impact analysis of the proposed Decker Mines consistent with the boundaries chosen for the remainder of the social and economic impacts analysis, a three county area was selected: Rosebud and Big Horn Counties in Montana, and Sheridan County, Wyoming. Since 1960 the level of population within the impact area has remained relatively static, although a population increase apparently stimulated by local coal development is evident in the 1970-74 Census Bureau reports. The three county region now contains six operating strip mines. Twelve major assumptions concurring with development of the proposed Decker mines are used as the basis for estimating population change in the area impacted. Based on these assumptions, a population peak is indicated in 1980 with an increase of 1,902 persons. The proposed East Decker operation is projected to be responsible for approximately 80% of the Decker-related population growth. Sheridan County is projected to receive 90% of the mine's population impact. Big Horn County is projected to receive 10%, while Rosebud County is not expected to experience a measurable amount of population change as a result of the Decker proposals.

PUBLICATIONS: Unpublished manuscript.

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PROJECT TITLE: Developing Economic Impact Projection Models for the Fort Union Coal Region (EPA No. 68-01-3507)

INVESTIGATORS/ORGANIZATION: T.A. Hertsgaard, F.L. Leistritz, N.L. Dalsted, A.G. Lehol, North Dakota State Univ., Dept. of Agricultural Economics, Fargo, ND 58102, (701) 237-7441

FUNDING AGENCY: U.S. Environmental Protection Agency

DURATION: 7/75 - 6/77 (Completed) LOCATION: MT, ND, WY

DESCRIPTION: Phase I: Objective - To investigate the usefulness of input-output coefficients developed for North Dakota in describing inter-industry relationships in the coal development impact areas of eastern Montana and northeastern Wyoming. Approach - Input-output technical coefficients will be estimated for four sectors (petroleum, petroleum refining, coal extraction, and coal-fired electric power generation). These sectors will be added to the matrix of technical coefficients previously estimated for other sectors and the augmented matrix will be inverted to obtain an interdependence

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coefficients matrix. Secondary sources will be utilized to estimate final demand vectors for the Fort Union areas of Montana and Wyoming. Interdependence coefficients will be applied to the final demand vectors and the resulting estimates of personal income will be compared with those reported by the U.S. Department of Commerce. If the comparison is satisfactory, Phase III can be initiated - otherwise Phase II can be initiated. Phase II: Modify input-output tables to obtain coefficients which more accurately depict inter-industry relationships in the Fort Union coal impact areas. Phase III: Employ the input-output model to assess the potential effects of coal development in the Fort Union Region.

PUBLICATIONS: T.A. Hertsgaard, et. al. Developing Economic Impact Projection Models for the Fort Union Coal Region (EPA 908/4-77-009).

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PROJECT TITLE: Development of a Procedures Manual for Assessing the Socio-Economic Impact of the Construction and Operation of Coal Gasification and Liquefaction Plants

INVESTIGATOR/ORGANIZATION: David Williams, John G. Reilly, Booz, Allen and Hamilton, Inc., 1025 Connecticut Ave., NW, Washington, D.C., (202) 293-3600

FUNDING AGENCY: Old West Regional Commission FUNDING AMOUNT: \$32,322

DURATION: 3/74 - 6/74 (Completed) LOCATION: MT, NE, ND, SD, WY

DESCRIPTION: Problem - To devise a detailed methodology for evaluating socio-economic impacts in areas faced with rapid growth and development. Objective - A manual for proceeding to evaluate same. Approach - Contractor devised a dollar-flow model, so that the impacts measured may be most properly identified as economic. Analysis provides detailed formulae for data inputs and manipulation of data inputs. Manual suggests sources for input data in the five Old West States.

PUBLICATIONS: A Procedures Manual. 1974. Booz, Allen & Hamilton, Inc.

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PROJECT TITLE: Economic Analysis of the Impact of Coal and Oil Shale Development on Environmental Quality in Rural Areas

INVESTIGATORS/ORGANIZATIONS: Joseph R. Barse, Project Leader, Natural Resource Economics Division, Economic Research Service, U.S. Department of Agriculture, 500 12th Street, SW, Washington, D.C. 20250 (202) 447-2667. Other investigators include: John W. Green, Virgil Whetzel, Mel Skold, c/o Economics Dept., Colorado State Univ., Fort Collins, CO 80523 (303) 483-9279, and Wally McMartin, North Dakota State University, Fargo, ND

FUNDING AGENCIES: U.S. Environmental Protection Agency; U.S. Department of Agriculture, Economic Research Service

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FUNDING AMOUNT: EPA - FY77 \$198,000, Prior \$198,000; USDA - FY 77 \$40,000, Prior \$40,000

DURATION: 7/75 - 9/80

LOCATION: Initially Northern Great Plains and Rocky Mountain States. Later on Interior and Eastern States.

DESCRIPTION: The general objective of this project is to assess many specific socio-economic impacts and implications of coal and oil shale development and to integrate these separate assessments into an interregional analytical system. The system can then be used to make comparative assessments of alternative patterns of coal and oil shale development which might be chosen by private decision-makers and public policy-makers. Work has begun on the following tasks: (1) To provide regional reports on resources available to meet alternative demands for new energy, land and water resources which would be affected, and economic implications for agriculture; (2) To evaluate costs of reclaiming mined lands at specific sites, assuming alternative reclamation technologies; (3) To develop an analytical system for evaluating inter-regional economic implications and tradeoffs for agriculture and rural areas resulting from coal development; and (4) To assess the demand for water for energy development and the competition for water between agriculture and energy use in coal mining and processing. (NOTE: This study is part of an ERS/USDA research program on The Economic and Social Consequences of Coal and Oil Shale Development, Project No. 297.)

PUBLICATIONS: Numerous. Contact project leader for availability.

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PROJECT TITLE: Economic Analysis of the Impacts of Coal Development in Montana

INVESTIGATOR/ORGANIZATION: Richard L. Stroup, Agricultural Economics and Economics Dept., Montana State Univ., Bozeman, MT 59715, (406) 994-3701

FUNDING AGENCY: Montana State University, Agricultural Experiment Station

DURATION: 7/75 - Continuing

LOCATION: MT

DESCRIPTION: Conduct economic analysis on one or more problems posed by coal development to Montana agriculture and rural development, with initial priority on the question of strip mine reclamation. Coordinate present and expected coal development research within the Dept. of Agricultural Economics and Economics and between the Department researcher effort and other researchers, funding agencies, and potential users of the data outputs. Approach - Coordination implies keeping abreast of coal research developments including the activities of other researchers, funding agencies, and data users. Economic analysis of reclamation alternatives will be approached on the cost side of cost synthesis, in a fashion similar to farm budgeting studies; methodology for approaching other unresearched and important questions remains to be determined.

297

PROJECT TITLE: The Economic and Social Consequences of Coal and Oil Shale Development

INVESTIGATORS/ORGANIZATIONS: Contact Lyle Schertz, Deputy Administrator, Economic Research Service, U.S. Department of Agriculture, 500 12th Street, SW, Washington, D.C. 20250, (202) 447-3710. Two divisions within the ERS/USDA are involved in this research program: The Economic Development Division (Lloyd Bender, Montana State University, Project Leader), and The Natural Resource Economics Division (Joseph Barse, USDA, Washington, D.C., Project Leader). Research is located at Montana State University, Colorado State University, North Dakota State University, University of Minnesota, and in Washington, D.C.

FUNDING AGENCIES: U.S. Environmental Protection Agency; U.S. Department of Agriculture, Economic Research Service

FUNDING AMOUNT: Approx. FY77 \$526,000; Prior \$396,000

DURATION: 6/75 - 9/80

LOCATION: Northern Great Plains initially; later on Interior and Eastern States

DESCRIPTION: Objectives - (1) Describe current resource use in coal and oil shale extraction and assess agricultural economic implications, resource competition and use, resulting from alternative future coal and oil shale development. (2) Estimate impact of energy development on local government finances and services, including revenue potential. Analyze interrelationships of local government expenditures to employment, population, income, age structure and other socio-economic variables. (3) Evaluate costs of mined land reclamation and uses for land after mining. (4) Evaluate inter-regional economic implications and trade offs for agricultural and rural areas resulting from coal development. (5) Evaluate effects of increased water demand for coal development on agricultural industries, environmental quality and rural resource use. Approach - Gather data, describe current situation. Make evaluations for local areas called homogeneous coal producing areas (HPA's), and aggregate these into regions and into an interregional analytical system. System will employ linear, or if appropriate, non-linear programming under alternative public policy constraints and objective functions to rationalize future or alternative allocation of extractive, reclamation, transportation, and energy activities among HPA's and regions.

PUBLICATIONS: Numerous. USDA, ERS, in Washington, D.C. for information.

298

PROJECT TITLE: Economic Study of the Decker-Birney, Montana Coal Area

INVESTIGATORS/ORGANIZATION: Maxine C. Johnson, Randle V. White, Bureau of Business and Economic Research, University of Montana, Missoula, MT 59801 (406) 243-5113

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Land Management; U.S. Department of Agriculture, Forest Service, Custer National Forest (through the Montana Energy Advisory Council)

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FUNDING AMOUNT: \$8,000 (BLM); \$4,000 (FS)

DURATION: 12/74 - 6/75 (Completed)

LOCATION: MT - Big Horn Co. (Busby-Decker), Rosebud Co. (Ashland-Lame Deer), Powder River Co. (Stacey and Otter)

DESCRIPTION: The Decker-Birney economic study is, in many ways, an extension of research concerning the economic impact of coal development in eastern Montana recently completed by the Bureau of Business and Economic Research at the University of Montana. The distinguishing feature of the Decker-Birney Study is that it centers on a small spatial area -- parts of several counties -- rather than a multicounty region. The Decker-Birney area economy was analyzed in terms of population, income and employment. Agriculture, mining, wood products, and recreation are singled out for special attention. Community institutions and governmental finances and services are described. Projections of population, employment, and income to 1980 and 1985, corresponding to alternative levels of coal development are developed and the outlook for the industries listed above are described. A final section brings the various topics together in an integrated discussion of the impact of coal-related development.

PUBLICATIONS: Randle V. White. The Decker-Birney-Ashland Area and Coal Development: An Economic Study. June 1975.

299

PROJECT TITLE: An Economic Study Relating to the Decker Coal Company Mine Proposals

INVESTIGATOR/ORGANIZATION: Paul E. Polzin, Bureau of Business and Economic Research, University of Montana, Missoula, MT 59801, (406) 243-5713

FUNDING AGENCY: Partly funded by a Decker Coal Company grant to the Mt. Dept. of State Lands for the Decker EIS.

FUNDING AMOUNT: Approx. \$6,500

DURATION: 7/75 - 10/75 (Completed)

LOCATION: MT - Big Horn and Rosebud Counties, WY - Sheridan County

DESCRIPTION: Three counties surrounding the proposed North Extension and East Decker Mines were defined as the local economic impact area; they are Big Horn and Rosebud Counties in Montana, and Sheridan County in the extreme northern portion of Wyoming. The majority of the economic impacts are projected to occur in the city of Sheridan in Sheridan County, the trade and services center for the region and located within 30 miles of both projects. The proposed Decker mines will create direct employment for basic workers (miners, railroad employees, construction workers) as well as result in the creation of additional derivative jobs by an increase in the demand for services and goods. When measured in terms of employment, the maximum impact of the proposed Decker mines is projected for 1980, when there will be between 792 and 962 additional employment opportunities. The removal from agricultural production of approximately 6,300 acres by fencing by the Decker Coal Company is projected to reduce the total output of farms and ranches in the area, although the adverse economic impact of this action is expected to be relatively

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minor. The State of Montana and local governments in the Montana portion of the impact area are projected to have sizable revenue surpluses from the proposed Decker mines. Governments in Wyoming, however, will probably experience deficits, as the increase in operating expenditures far exceed the growth in revenues.

PUBLICATIONS: Unpublished manuscript.

300

PROJECT TITLE: ERDA Quick Response Support (Energy Policy Analysis-Task I)

INVESTIGATORS/ORGANIZATIONS: John S. Gilmore, Dona Flory, Diane Hammond, Keith Moore, University of Denver Research Institute, Industrial Economics, 2135 E. Wesley Ave., Denver, CO 80208, (303) 753-3207; Subcontractor - Dean C. Coddington of Bickert, Browne, Coddington & Associates.

FUNDING AGENCY: U.S. Energy Research and Development Administration

FUNDING AMOUNT: \$41,389

DURATION: 3/77 - 8/77 (Completed)

LOCATION: MT, MA, LA, KY, IL, CO

DESCRIPTION: This project compares state procedures and institutions for avoiding or alleviating socioeconomic impacts, and identifies possible effects these governmental mechanisms may have on energy development.

PUBLICATIONS: (1) John S. Gilmore, et. al. Socioeconomic Impact Mitigation Mechanisms in Six States -- Generalizations and Unresolved Issues. (2) Final report will be available through the ERDA Office of Policy Analysis and Evaluation about November 1977.

301

PROJECT TITLE: Fiscal Impact of Coal Development on Local Government

INVESTIGATOR/ORGANIZATION: Maxine Johnson, Bureau of Business and Economic Research, University of Montana, Missoula, MT 59801, (406) 243-5713

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service (Custer National Forest) - through the Montana Energy Advisory Council

FUNDING AMOUNT; \$20,559

DURATION: 3/75 - 9/76 (Completed)

LOCATION: MT

DESCRIPTION: Case study of coal development fiscal impact on state and local government and development of methodology for future impact studies.

PUBLICATIONS: Maxine C. Johnson and Randle V. White. Coal Development, Population Growth, and Local Government Finance: A Handbook for Local Officials. November 1976.

302

PROJECT TITLE: Managing Socioeconomic Impacts of Energy Developments

INVESTIGATORS/ORGANIZATION: Michael Frankel, Isabel Reiff, Centaur Management Consultants, Inc., 1120 Connecticut Avenue, NW, Washington, D.C. 20036, (202) 296-4100

FUNDING AGENCY: U.S. Energy Research and Development Administration

DURATION: 3/76 - 7/77 (Completed)

LOCATION: Nationwide

DESCRIPTION: The purpose of this study is to provide local, state and regional officials a means to categorize and evaluate socioeconomic impacts of energy development scenarios. The methodology for socioeconomic impact assessment begins with economic baseline data and energy development projections. From these economic and job projections come population earnings, personal income, and retail sales projections. After population projections are made, demands for housing, education, health facilities, transportation, sewer and water can be projected and expected demands for public services (police, fire, capital budget programs) as well as public revenues can be derived. Other impacts such as visual quality, historic resources, cultural resources, and the whole range of impacts on the physical environment are described but not developed to the extent of the major socioeconomic impacts. The handbook which was prepared as a result of this study provides planning officials and decision-makers with alternative methodologies for formulating projections of alternative energy development impacts. The projected impacts are based on the alternative energy development scenarios involving the coal and synthetic fuel industries. These industries include coal extraction, coal processing, coal combustion, coal conversion and oil shale conversion. To assist local areas impacted by energy development, the handbook discusses federal assistance programs covering local and state planning, implementation and construction programs.

PUBLICATIONS: Managing Socioeconomic Impacts of Energy Developments - A Guide for the Small Community. ERDA Report #77-79.

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PROJECT TITLE: Health Impacts of Environmental Pollution in Energy Development Impacted Communities

INVESTIGATOR/ORGANIZATION: Melvin H. Goodwin, Copley International, 7817 Hershel Ave., La Jolla, CA 92038, (714) 454-0391

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT; FY77 \$42,898; Prior \$53,736

DURATION: 1/76 - 11/77 (Completed)

LOCATION: MT, WY, UT, ND, SD, CO

DESCRIPTION: This project was designed to evaluate the relative extent of health impacts resulting from development of energy resources in Federal Region VIII. The following tasks were involved: (1) Appraise the relative significance of current or potential impacts on communities; (2) Determine the scope and adequacy of health information available in state repositories and summarize

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available relevant material; (3) Analyze available data to explore relationships between environmental pollution and health impacts, assess economic aspects of providing needed health, environmental, and community services; (4) Develop survey protocols for use in securing information related to health impacts from sources in affected communities.

PUBLICATIONS: Health Impacts of Environmental Pollution in Energy-Development Impacted Communities, Vols. I, II, Final Report Phase I. September 1976; Final Report, Phase II, November 1977. By Copley International Corporation, La Jolla, CA.

304

PROJECT TITLE: Impact of Coal Development on Public Services in the Northern Plains States

INVESTIGATORS/ORGANIZATION: Anne S. Williams and Donald W. Patterson, Institute of Applied Research, Montana State University, Bozeman, MT 59715, (406) 994-3835

FUNDING AGENCY: U.S. Department of the Interior, Northern Great Plains Research Program

FUNDING AMOUNT: \$8,500

DURATION: 9/73 - 8/74 (Completed)

LOCATION: MT - Big Horn and Rosebud Counties; WY - Sheridan and Campbell Counties; ND - Mercer and Oliver Counties

DESCRIPTION: Objectives were to: (1) Identify the public service needs which would accompany three levels of projected coal development in the three Northern Plains states; (2) Determine the sources and amount of tax revenue likely to be generated under the three coal development scenarios; (3) Identify the disparities (if any) between public service needs and availability of revenue to pay for them; and (4) Make policy recommendations to correct identified public service delivery problems. Major policy relevant conclusions were: (1) Existing public services in none of the six counties studied could adequately accommodate the level of population growth anticipated under any of three coal development scenarios; and (2) Projected revenues from coal development would not be sufficient in the first five years to pay for needed services. Over the long term, projected revenues would exceed service costs in five of the six counties - but, in Sheridan County, Wyoming, projected revenues would lag behind projected service costs indefinitely into the future.

PUBLICATIONS: Anticipated Effects of Major Coal Development on Public Services, Costs and Revenues in Six Selected Counties. Research Report #82, Montana Agricultural Experiment Station, Montana State Univ., Bozeman, MT 59715. April 1975.

305

PROJECT TITLE: The Impact of Energy Development in the Northern Great Plains on Employment, Income, and Population and on Local Government Revenues and Services

INVESTIGATORS/ORGANIZATIONS: Lloyd D. Bender, Project Leader, Economic Development Division, Economic Research Service, U.S. Department of Agriculture, Montana State University, Bozeman, MT 59715, (406) 994-3701. In addition to the Montana work, research is located at North Dakota State Univ. (Stanley Voelker), Univ. of Minnesota (Thomas Stinson), and in Washington, D.C.

FUNDING AGENCIES: U.S. Environmental Protection Agency; U.S. Department of Agriculture

FUNDING AMOUNT: This research is sponsored by U.S. EPA interagency fund transfers of slightly less than \$400,000 year to the U.S. Dept. of Agriculture, Economic Research Service. The basic support is split evenly between the Natural Resource Economics Division (see Project No 295) and the Economic Development Division (this project).

DURATION: 7/75 - 9/80

LOCATION: Northern Great Plains

DESCRIPTION: The overall objective of this project is to determine methods of estimating population, employment, income, local and state revenue flows, local expenditures, and net fiscal impacts in rapid growth communities in the Northern Great Plains due to coal mining and conversion. (NOTE: This study is part of an ERS/USDA research program on The Economic and Social Consequences of Coal and Oil Shale Development, Project No. 297).

PUBLICATIONS: Numerous. Contact project leader for list and for information on availability.

306

PROJECT TITLE: Indian Lignite Manpower Project (EDA No. 05-06-01563)

INVESTIGATORS/ORGANIZATION: Douglas J. Myers, Arnie Guimont, Donald Schwartz, United Tribes Educational Technical Center, 3315 S. Airport Road, Bismarck, ND 58501, (701) 255-3285

FUNDING AGENCY: U.S. Department of Commerce, Economic Development Administration

FUNDING AMOUNT: \$104,833 7/75 - 9/78 (additional funds proposed for 1978)

DURATION: 7/75 - 9/78

LOCATION: MT, ND

DESCRIPTION: The general objective of this project is to reduce unemployment among Indian people by providing a means for North Dakota and Montana Indian people to seek and successfully compete for jobs in the newly expanding lignite industry in these states. More specifically, the Indian Lignite Manpower Project will (1) Collect information regarding the size and composition of the available Indian labor force from reservations in North Dakota and eastern Montana and from urban areas near these reservations; (2) Develop working relationships with companies presently or potentially involved in lignite development

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in order to determine their manpower needs, to provide training for company personnel in hiring and retaining Indian people, and to develop assurances from the companies that Indian people willing to train, and if necessary relocate, would have an opportunity to obtain employment; (3) Develop working relationships with relevant labor unions to insure that Indian people interested in lignite employment would not encounter membership barriers and that they would have some promise of a portion of the apprenticeship positions; (4) Work with existing vocational education institutions and other sponsors to develop specific training programs in high need areas and to facilitate the entry of interested Indian people into those programs; and (5) Initiate an intensive and effective recruiting activity, plus mechanisms for its continuation after termination of the project, which would move interested Indian people into employment in the construction and operation phases of coal mining and coal conversion facilities, or, if needed, into training and then into those positions.

PUBLICATIONS: Donald F. Schwartz. Reservation Manpower Survey: Indian People's Interest in Lignite Industry Employment. January 1977.

307

PROJECT TITLE: LIMA and SIAM Impact Assessment Models Assessment Test

INVESTIGATORS/ORGANIZATION: George Piccagli, Robert Kimble, Sue Adams, Institute for Policy Research, University of Wyoming, P.O. Box 3925, University Station, Laramie, WY 82071, (307) 766-4338

FUNDING AGENCY: Battelle Pacific Northwest Labs, Richland, WA 99352

FUNDING AMOUNT: \$25,000

DURATION: 5/77 - 11/77

LOCATION: MT - Rosebud, Powder River, and Big Horn Counties, WY - Sheridan, Campbell, Converse, Johnson, and Sweetwater Counties

DESCRIPTION: Data on sixty-five social indicators is being gathered in the Powder River Basin of Montana and Wyoming. The data will be utilized to test the Local Impact Management and Assessment Model (LIMA) and the Social Impact Assessment and Management Model (SIAM).

308

PROJECT TITLE: Macro Economic Impact of Coal and Oil Shale Development in the Intermountain West (FEA CO-04-50328-00)

INVESTIGATOR/ORGANIZATION: C. Lewis, Office of Resource Development, Agricultural Science Building, Room 223A, Utah State University, Logan, UT 84321

FUNDING AGENCY: U.S. Federal Energy Administration

FUNDING AMOUNT: \$99,950

DURATION: 7/75 - 2/77 (Completed)

LOCATION: MT, WY, UT, NM, CO

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DESCRIPTION: The contractor produced a multi-state interregional input-output model which will evaluate the extent and magnitude of economic growth by sector resulting from alternative levels of coal, oil shale refining, coal gasification, electric power generation, and energy product transmission pipelines in the five-state area of Colorado, Wyoming, Montana, Utah, and New Mexico. Projections through 1985 are made in order to evaluate the impacts on future employment, sector output, and industry growth derived from various rates of coal and oil shale development. Impacts on the public sector are also traced. Side effects from development are evaluated (e.g., environmental change, and change in social well-being).

PUBLICATIONS: Macroeconomic Impacts of Coal and Oil Shale Development in the Intermountain West. Economics Dept., Utah State University, Logan, UT 84322.

309

PROJECT TITLE: Montana Community Technical Assistance Program

INVESTIGATOR/ORGANIZATION: Montana Dept. of Community Affairs, Helena, MT

FUNDING AGENCY: Old West Regional Commission

FUNDING AMOUNT: \$313,581 6/76 - 6/78; \$288,062 3/75 - 3/77 (This is two separate programs involving different communities.)

LOCATION: Eastern Montana

DESCRIPTION: The Community Technical Assistance Program is developed to assist communities experiencing or anticipated to experience energy development impact. Technical manpower, training programs and planning support is being provided to impact areas in Eastern Montana.

310

PROJECT TITLE: Montana Futures Process

INVESTIGATOR/ORGANIZATION: C.R. Draper, Research and Information Systems, Mt. Dept. of Community Affairs, Helena, MT 59601, (406) 449-2896

FUNDING AGENCY: Old West Regional Commission through the Public Investment Planning funds.

FUNDING AMOUNT: \$39,000

LOCATION: MT - Statewide

DURATION: 9/75 - 8/76 (Continuation work is not energy-related)

DESCRIPTION: A computer simulation routine designed to serve as a quantitative tool in the appraisal of the economic and demographic impacts of a wide range of possible economic developments. The system is capable of analyzing both the long-run growth prospects of substate regions as well as the employment, population, and income effects of a change in activity within thirty-five industrial sectors. This technique has focussed on analysis of energy-related growth.

311

PROJECT TITLE: Population Estimates of Southeastern Montana

INVESTIGATOR/ORGANIZATION: Patrick Jobes, Department of Sociology, Montana State University, Bozeman, MT 59715, (406) 994-4201

FUNDING AGENCY: U.S. Department of Agriculture, Cooperative States Research Service

DURATION: 7/74 - 6/75

LOCATION: MT - Big Horn, Powder River, Rosebud, and Yellowstone Counties

DESCRIPTION: Objective - Provide preliminary population projections of size composition and distribution in four counties in Southeastern Montana, in association with local mining and construction development. Approach - Explore secondary data sources utilizing Whelpton's components of population method. It provides a range of projections; takes into account demographic changes responsible for population growth; is intuitively easy to comprehend by potential users. Explore additional data sources by communication with developing companies. Literature dealing with population estimates in rapidly growing areas was reviewed. Interviews were taken with several major decision-makers who have knowledge concerning future development in coal development in southeastern Montana.

PUBLICATIONS: Final Report. Check with investigator for availability.

312

PROJECT TITLE: Rapid Growth from Energy Projects -- Ideas for State and Local Action

INVESTIGATORS/ORGANIZATION: Hubert Van Dyke, Emmett Turner, David Williams, U.S. Department of Housing and Urban Development, Washington, D.C. 20410

FUNDING AGENCIES: U.S. Department of Housing and Urban Development; U.S. Federal Energy Administration

FUNDING AMOUNT: \$5,500 (FEA) DURATION: 6/75 - 3/76 (Completed)

LOCATION: No. Great Plains, Rocky Mountain states, Appalachia

DESCRIPTION: The purposes of this project are to: (1) Show what the community impacts of energy projects are likely to be; (2) Share ideas for action among communities, based on actual experiences; and (3) Point out sources of help -- for information, planning and financial assistance. To be of value in planning for and responding to energy project impacts, the emphasis of this project was on ideas for action. There have been many studies of the impacts, actual and projected. What is needed now are ideas on what to do to prepare for the impacts. There is a concentration on western coal projects in this project. That is where the largest number of cases are presently available.

PUBLICATION: Rapid Growth from Energy Projects -- Ideas for State and Local Action: A Program Guide. Available from U.S. HUD, Washington, D.C. 20410.

313

PROJECT TITLE: Review Relevancy of "Multiple-Objective Planning for Multi-Purpose Water Resource System: A Structure for Regional Water Resource Development"

INVESTIGATORS/ORGANIZATION: Dirk Lijesen, Nicolaos V. Arvanitidis, INTASA, 1120 Crane Street, Menlo Park, CA 94025

FUNDING AGENCY: Old West Regional Commission FUNDING AMOUNT: \$5,000

DURATION: 12/74 - 3/75 (Completed) LOCATION: MT, NE, ND, SD, WY

DESCRIPTION: Problem: To explore the feasibility and desirability of developing a common planning and evaluation methodology broad enough to encompass the wide range of concerns (economic, social, and environmental) that stem from energy development. Objective - See above. Conclusion was generally negative. Approach - INTASA has done multi-objective planning work for the Corps of Engineers, using a system of social, economic, and environmental accounts. The contractor compared experience and product of that effort to problems peculiar to western energy development. In the course of the examination, contractor reviewed a number of familiar studies, including the Northern Great Plains Resource Program and the Eastern Powder River Basin Environmental Impact Statement.

PUBLICATIONS: Letter report available from Old West Regional Commission, 1730 "K" St., NW, Suite 426, Washington, D.C. 20006

314

PROJECT TITLE: Rosebud County, Montana, Economic-Demographic Analysis, Baseline and Projections, 1976 - 1990

INVESTIGATORS/ORGANIZATION: Eric Anderson, James A. Chalmers, Mountain West Research, Inc., 1739 Grand Avenue, Billings, MT 59102

FUNDING AGENCY: Old West Regional Commission FUNDING AMOUNT: \$9,000

DURATION: 4/76 - 6/76 (Completed) LOCATION: MT - Rosebud Co.

DESCRIPTION: Project involved current and historic analysis of county population and economic sectors. An analysis of potential development including coal strip mining, power generation, and gasification including development of Northern Cheyenne Reservation area coal resources was made, and four alternative scenarios were prepared providing employment and population on a county and community specific basis. A computer model was prepared and can be updated as new material becomes available.

PUBLICATIONS: Limited number of reports available for \$7.50 each from Cumin Associates, P.O. Box 20762, Billings, MT 59104.

315

PROJECT TITLE: The Social, Economic, and Land Use Impacts of a Hypothetical Coal Processing Complex Applied to the Fort Union Lignite Region

INVESTIGATORS/ORGANIZATION: John S. Gilmore, Mary K. Duff, Dick Doran, Dean C. Coddington, University of Denver Research Institute, Industrial Economic Div., 2135 E. Wesley Avenue, Denver, CO 80210, (303) 753-3207

FUNDING AGENCY: U.S. Energy Research and Development Administration

FUNDING AMOUNT: \$237,668

DURATION: 9/73 - 8/75 (Completed)

LOCATION: MT, ND, SD

DESCRIPTION: This project involved estimating the social, economic, and land use impacts related to second generation coal conversion technology on a rural isolated community in the western United States. The intent was to develop a methodology for estimating impacts which would be applicable to other communities facing similar development. The project involved developing a profile of a hypothetical coal-oil-gas complex (COG) in terms of land, labor, and capital required. Then an area which typifies western communities was selected to superimpose the COG complex (construction of such is not anticipated before 1985.) Two representative areas were selected for detailed study: (1) Rural areas -- three counties in southwest ND and (2) Urban areas - five counties, including Bismarck-Mandan area. Forecasts of new coal-related development, employment and population and income were superimposed on this forecast. Public (water, sewer, recreation, etc.) and private (housing, health, utilities, retail space, etc.) were estimated. The cost of this infrastructure was estimated. Federal, state, and local tax revenues flowing from the development were prepared and compared with expenditure requirements for a public sector cash flow analysis using two different assumptions: (1) Direct comparison of all expenditures and all revenues; and (2) Assuming all capital outlays deferred and financed by 20 year public bonds. The changes in economic structure are presented on a growth management model. The model indicates capital investment needed to accommodate the new population, and the relationships between investment, land and labor. Growth management functions and implementation tools were suggested. The societal changes resulting from industrialization and urbanization of both areas were modeled according to social structure, policy, culture and institutional.

PUBLICATIONS: Factors Influencing an Area's Ability to Absorb a Large-Scale Commercial Coal-Processing Complex: A Case Study of the Fort Union Lignite Region. Report FE 1526-2. August 1975. Available from NTIS, Springfield, VA.

316

PROJECT TITLE: A Social Impact Study of Constructing Colstrip Generating Plants #3 and #4

INVESTIGATOR/ORGANIZATION: Raymond L. Gold, Institute for Social Research, University of Montana, Missoula, MT 59801, (406) 243-5411

FUNDING AGENCY: State of Montana (Mt. Dept. of Natural Resources and Dept. of Social and Rehabilitation Services)

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FUNDING AMOUNT: \$20,000

DURATION: 12/74 - 10/75 (Completed)

LOCATION: MT - Rosebud County (Colstrip)

DESCRIPTION: The purpose of this project was to study the impact of the proposed construction of Colstrip generating plants #3 and #4 on the people living in and around Rosebud County. A lengthy questionnaire was administered to a representative sample of residents of Rosebud County south of the Yellowstone River, excluding the Northern Cheyenne Reservation. The research team also interviewed residents of the same area whom the locals identified as representing all the known viewpoints and social groupings.

PUBLICATIONS: (1) Social Impact Study of Colstrip Generating Plants #3 and #4 Summary of Interview Data. July 31, 1974; (2) Social Impact of Existing and Proposed Coal Development: A Survey of the Rosebud County Study Area Residents. August 30, 1974.

317

PROJECT TITLE: Socio-economic Baseline Report for Crow Indian Coal Leases

INVESTIGATORS/ORGANIZATION: Jan Barringer, Dwayne Jelinek, J.A. Chalmers, Mountain West Research, Inc., 123, E. University Dr., Suite 219, Tempe, AZ 85281

FUNDING AGENCY: Westmoreland Resources, Hardin, MT

FUNDING AMOUNT: \$67,000

DURATION: 1/75 - 12/75 (Completed)

LOCATION: MT - Yellowstone, Big Horn, Rosebud, Treasure, Custer, Powder River Counties

DESCRIPTION: The object of the study was to provide baseline information for the preparation of impact assessments associated with the viewing of Crow coal by Westmoreland Resources Company. The study had four sections. The regional analysis uses an economic-demographic simulation model to examine the alternative uses an economic-demographic simulation model to examine the alternative futures that may face the six-county study area. The second section investigates the public revenue and expenditure implications of coal development. A detailed examination is then made of social and economic conditions in a three county primary impact area (Big Horn, Rosebud and Treasure Counties). Emphasis is placed on accurately portraying the extent and adequacy of public facilities and housing, the fiscal situation of county and municipal jurisdiction, and the attitudes of area residents towards coal development. The final section examines social and economic conditions on the Crow Reservation.

PUBLICATIONS: Environmental Baseline Studies for Crow Indian Coal Leases: Socioeconomic Report. Prepared by Mountain West Research, Inc. December 1975. Available From Mountain West Research, Inc.

COAL/Social and Economic Studies

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PROJECT TITLE: The Socioeconomic Impact of Energy Development on the Crow and Northern Cheyenne Indian Tribes

INVESTIGATORS/ORGANIZATIONS: Jean Nordstrum, Northern Cheyenne Research Project, Lame Deer, MT 59043; Yvonne Fighter, Crow Office of Coal Research, Crow Agency, MT

FUNDING AGENCY: Old West Regional Commission

FUNDING AMOUNT: \$257,900

DURATION: 5/76 - 7/77 (Completed)

LOCATION: MT - Crow and Cheyenne Reservations

DESCRIPTION: The Crow and Northern Cheyenne Reservations, located in southeastern Montana, contain an estimated ten billion tons of coal. In order to make wise decisions, more information is needed on the current conditions existing on both reservations. This information can then provide a basis for making an estimation of the changes which coal development might bring and the manner in which the Indian people can take advantage of development benefits if they choose to have the coal developed. Objectives of the project are: (1) To evaluate the current socioeconomic and cultural conditions prevailing on the reservations for baseline purposes; (2) To determine the prevailing attitudes and feelings of reservation inhabitants toward reservation energy development; (3) To establish socioeconomic projections for the Crow and Northern Cheyenne Reservations, given different assumptions of economic development; (4) To establish reliable impact research methods to provide the tribes in the West with mechanisms that will allow them to periodically monitor social change on the reservation brought about by growth and development on and near the reservation; (5) To train tribal persons in all phases of the research to provide an indigenous group of tribal members that can periodically update the information proposed for collection.

PUBLICATIONS: A summary report, Crow Report, and a Northern Cheyenne report will be available after June 1977.

319

PROJECT TITLE: Socio-Economic Impact Study of Coal and Oil Shale Boom Towns (FEA No. CO-04-50197-00)

INVESTIGATORS/ORGANIZATION: John S. Gilmore, Mary K. Duff, Dean C. Coddington, University of Denver Research Institute, Industrial Economics Division, 2135 E. Wesley Avenue, Denver, CO 80210

FUNDING AGENCY: U.S. Federal Energy Administration

FUNDING AMOUNT: \$74,500

DURATION: 5/75 - 9/76 (Completed)

LOCATION: CO, MT, WY, UT

DESCRIPTION: Identification of socio-economic and fiscal problems associated with the development of oil and coal reserves between 1975-2000 (in CO, MT, WY, UT). In each community, in the four states under analysis, capital needs for public and private services were identified. The contractor evaluated the implications of boom town development for Federal and State policy. A detailed

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examination of feasible financing solutions at the local, state and federal levels was presented. They involved: subsidies (federal and state), property taxes, severance taxes, income taxes, as well as loans. Each financing option was looked into in terms of its constitutional limits, economic efficiency, administrative feasibility, equity, and risk.

PUBLICATIONS: John Gilmore, et. al, Analysis of Financing Problems in Coal and Oil Shale Boom Towns. July 1976. Available from NTIS (PB259-438).

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PROJECT TITLE: Socioeconomic Longitudinal Monitoring Project

INVESTIGATORS/ORGANIZATION: Audie L. Blevins, James G. Thompson, Robert L. Kimble, Robert Wisniewski, Department of Sociology, University of Wyoming, University Station, Laramie, WY 82071, (307) 766-3243

FUNDING AGENCY: Old West Regional Commission FUNDING AMOUNT: \$170,000

DURATION: 11/75 - 6/78

LOCATION: MT - Wheatland Co., WY - Platte Co., ND - McLean Co., NE - Kimball Co.

DESCRIPTION: Although many projections have been made about the socioeconomic impact of energy development, very little factual data has been gathered on actual impacts that have occurred in the region. It is proposed that a number of social and economic factors need to be measured over time to develop a clearer understanding of relationships between employment and population increases and socioeconomic changes. The objectives of this project are as follows: (1) To monitor selected social and economic variables over time; (2) To compare actual measured changes with projected changes in an attempt to isolate reasons for discrepancies; (3) To analyze measured changes to determine which are related to energy development, which can be generalized to any rapidly growing community and which are site-specific; (4) To make the results of the monitoring and analysis available to planners, administrators, and legislators throughout the Region in the form of both written reports and a computerized model for making impact projections. Two impact areas and two control areas will be monitored.

PUBLICATIONS: Socioeconomic Longitudinal Monitoring Project: First Year Progress Report. April 1977. Old West Regional Commission, 228 Hedden-Empire Bldg., Billings, MT 59101. Five volumes.

321

PROJECT TITLE: A Socio-Economic Study of the Proposed Shell Oil Company Pearl Mine

INVESTIGATORS/ORGANIZATION: Lauren McKinsey, James H. Nybo, Anne S. Williams, Patrick Jobes, David C. Williams, James Boyer, The Meadowlark Group, P.O. Box 1050, Helena, MT 59601, (406) 442-9873

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FUNDING AGENCY: State of Montana (Mt. Dept. of State Lands)

FUNDING AMOUNT: \$28,900

DURATION: 9/77 - 1/78 (Completed)

LOCATION: MT - Big Horn County; WY - Sheridan County

DESCRIPTION: This is a study pursuant to the development of an environmental impact statement by the Mt. Dept. of State Lands on their action relating to Shell Oil Co.'s proposal to open the "Pearl" mine in Big Horn County. The study has two primary aspects: (1) Quantify and qualitatively discuss the human impacts on the local area impact region associated with the mine; (2) Explore and formulate possible growth management strategies available to minimize, mitigate, and avoid the adverse effects of major energy development in a sparsely populated rural region of Montana or Wyoming.

PUBLICATIONS: Lauren McKinsey. A Socio-Economic Study of the Proposed Shell Oil Company Pearl Mine. January 1978. The Meadowlark Group, Helena, MT 59601.

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PROJECT TITLE: State Governments' Use of Funds Allocated from Mineral Leasing Act Receipts

INVESTIGATORS/ORGANIZATION: Maxine C. Johnson, Maureen F. Ullrich, Bureau of Business and Economic Research, University of Montana, Missoula, MT 59801, (406) 243-5113

FUNDING AGENCY: U.S. Department of the Interior, Office of Minerals Policy Development

FUNDING AMOUNT: \$5,260

DURATION: 7/76 - 9/76 (Completed)

LOCATION: MT, CA, CO, NM, UT, WY

DESCRIPTION: The Mineral Leasing Act of 1920 and the Acquired Mineral Leasing Act of 1947 provide that 37.5 percent of receipts from federal leases of mineral land should go to the states in which the lands are located. These moneys are to be used by the state or sub-divisions thereof, for the construction and maintenance of public roads or for the support of public schools or other public educational institutions as the legislature of the state may direct. Payments under these Acts in 1974 and 1973 by the states of CA, CO, MT, NM, UT, and WY are the areas of interest to be included in this project to study and investigate how Mineral Leasing Acts funds are used by these six states: (1) Develop how the funds are divided between public roads and education; (2) The proportion of the funds distributed to local governments and by what criteria; (3) Relationship between location of mineral lands leased/community impact, and the expenditure of Mineral Leasing Act receipts.

PUBLICATIONS: Written report submitted to USDI.

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PROJECT TITLE: A Study of the Legal and Regulatory Framework of Certain Issues Arising from Rapid and Substantial Population Growth

INVESTIGATORS/ORGANIZATION: Jeffrey J. Scott, William G. Campbell, Kutak, Rock, Cohen, Campbell, Garfinkle and Woodward, 600 Woodmen Tower, Omaha, NE 68102

FUNDING AGENCY: Old West Regional Commission

FUNDING AMOUNT: \$25,000

DURATION: 6/74 - 9/74 (Completed)

LOCATION: MT, WY, ND

DESCRIPTION: Problem - To identify the legal and regulatory tools and options available to communities to be impacted by rapid population growth. Objective - A baseline study of problems encountered and tools available to meet those problems, with specific attention to the present statutes of Montana, North Dakota, and Wyoming. Approach - (1) Review laws of Montana, Wyoming, and North Dakota - re-establishment of new towns, distinguishing features of existing classes of municipal structures, traditional zoning authority, and currently authorized alternative land use mechanisms; (2) Contact with concerned parties in the three states and elsewhere in the U.S.; (3) Contact elsewhere for comparative growth experience; (4) Survey of contemporary literature and summary of all known responses to the problem; (5) Synopsis of procedural and substantive tools; (6) Principles of model legislation.

PUBLICATIONS: Legal and Regulatory Framework of Coal Development in the Old West Region. September 1974. Kutak, Rock, Cohen.

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PROJECT TITLE: Study the Problem of Declining Local Economies and the Potential for Mitigating Measures in Affected Counties in Montana, North Dakota and Wyoming

INVESTIGATORS/ORGANIZATION: Edgar Rust, William Alonso, Berkeley Planning Associates, 2320 Channing Way, Berkeley, CA 94704

FUNDING AGENCY: Old West Regional Commission

FUNDING AMOUNT: \$5,000

DURATION: 12/74 - 2/75 (Completed)

LOCATION: MT, ND, WY

DESCRIPTION: Problem - While many counties in the states of MT, WY, and ND will experience rapid growth in the next decade, many other counties in the same states will experience continuing decline and net outmigration. These counties will be left with an aging population and a declining service sector. Objective - To study the situation with an eye to the potential for mitigating measures. Approach - (1) Literature search and bibliography on problems of decline; (2) Description of limitations of programs to reverse decline. Literature search and bibliography on mitigating measures; (3) Enumeration of potential measures; (4) Evaluation of mitigating measures; (5) Suggestions for future Old West Program.

PUBLICATIONS: Adaptation or Reversal: Policies for the Quality of Life in the Economically Declining Parts of Montana, North Dakota, and Wyoming. Berkeley Planning Associates. March 1975.

325

PROJECT TITLE: A Study of the Social Impact of the Allocation of Large Portions of Water from the Yellowstone River Drainage to Coal Related Industrial Development

INVESTIGATORS/ORGANIZATION: Lee Faulkner, Michael Howard, Anne Williams, Montana University Joint Water Resources Research Center, Montana State University, Bozeman, MT 59715, (406) 994-3701

FUNDING AGENCY: U.S. Department of the Interior, Office of Water Resources Research

FUNDING AMOUNT: \$27,475

DURATION: 1/75 - 7/76 (Completed)

LOCATION: MT - Yellowstone River Basin

DESCRIPTION: This project was designed primarily to encourage public dialogue on the questions of priorities, needs and potential impacts of water use for coal development during the three-year moratorium on water allocation in the Yellowstone River Basin. Two major phases are involved. In the first, the research phase, three methods are applied: (1) Information is obtained on water use and coal development plans, actions and options through in-depth interviews with decision-makers and influential persons in agencies, industry, the legislature and pressure groups; (2) A probability sample of residents of the study area, through responses to a mail questionnaire provides data on priorities and opinions concerning water use for coal development, and the impacts they would expect from increased development of the coal resources in the area; (3) Data from many sources concerning pressures for changes in water use, legislative trends concerning water and coal development, information on lawsuits also provides important background against which to assess the information obtained by methods one and two above. The effectiveness of the program as a tool for dialogue between decision-makers and the public is to be evaluated.

PUBLICATIONS: Lee Faulkner and Mike Howard. Preliminary Summary -- Private Opinions and Public Decisions: The Future of Water Use in the Yellowstone River Drainage. Montana University Joint Water Resources Research Center. October 1975. Also, Lee Faulkner. Issues and Opinions on the Social Effects of Water Allocation for Coal Development in the Yellowstone River Drainage. July 1976. Available for \$5.00 from the Mt. Univ. Joint Water Resources Research Center.

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PROJECT TITLE: A Study of Social Impact of Coal Development in the Decker-Birney Planning Unit

INVESTIGATOR/ORGANIZATION: Raymond L. Gold, Institute for Social Research, University of Montana, Missoula, MT 59801, (406) 243-5411

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Land Management; U.S. Department of Agriculture, Forest Service, Custer National Forest (through the Montana Energy Advisory Council)

FUNDING AMOUNT: \$35,550

DURATION: 7/74 - 6/75 (Completed)

LOCATION: MT - Rosebud, Big Horn, and Powder River Counties (Decker-Birney Planning Unit)

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DESCRIPTION: The purpose of this study was to supplement and complement the Decker-Birney Resource Study's findings concerning the human factors to be considered when examining the resources of the parts of Rosebud, Big Horn, and Powder River counties that formed the study area for the Decker-Birney Planning Unit, a geographic locale where local leases are administered by the Miles City, Montana, office of the Bureau of Land Management. The report is in the form of a summary and list of recommendations, most of which pertain to planning and to cost-benefit comparisons.

PUBLICATIONS. A Study of Social Impact of Coal Development in the Decker-Birney-Ashland Area, Final Report. May 31, 1975.

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PROJECT TITLE: Study of Social Structure and Service Impact of Proposed Expansion of Decker Coal Company Strip Mine Operations

INVESTIGATOR/ORGANIZATION: Raymond L. Gold, Institute for Social Research, Univ. of Montana, Missoula, MT 59812, (406) 243-5411

FUNDING AGENCY: State of Montana (Part of a Decker Coal Co. grant to the Dept. of State Lands)

FUNDING AMOUNT: \$18,000

DURATION: 7/75 - 10/75 (Completed)

LOCATION: MT - Big Horn Co. (Decker), WY - Sheridan

DESCRIPTION: The research was designed to provide an objective and impartial view of the area where social structure, way of life, and community services are likely to be impacted by expansion of mining operations at Decker, Montana. The principal study area was Sheridan, Wyoming where the impact of mine expansion will be far greater than on other communities. A questionnaire was administered to randomly selected respondents, and various representative locals were identified and interviewed in-depth.

PUBLICATIONS: (1) Social Impact Technical Appendix: Study of Social Structure and Service Impact of Proposed Expansion of Decker Coal Company Strip Mine Operations; (2) Study of Social Structure and Service Impact of Proposed Expansion of Decker Coal Company Strip Mine Operations: A Summary.

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PROJECT TITLE: Western Regional Energy Development Study: Economics

INVESTIGATOR/ORGANIZATION: Edward Cazalet, Stanford Research Institute, 333 Ravenswood Avenue, Menlo Park, CA 94025

FUNDING AGENCIES: U.S. Council on Environmental Quality, U.S. Environmental Protection Agency, U.S. Energy Research and Development Administration, U.S. National Science Foundation, U.S. Department of the Interior

FUNDING AMOUNT: \$370,000

DURATION: 1/75 - 11/76 (Completed)

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LOCATION: MT, AZ, CO, NM, ND, UT, WY

DESCRIPTION: Examined the economics of 38 different resource development scenarios of Phase I supply analysis that looks at capital investments, operating costs for extracting, converting, and transporting all forms of energy in AZ, CO, MT, NM, ND, UT, and WY. These data have been placed in a computer model along with the projections of U.S. energy demand to the year 2000. (NOTE: This study is part of a three phase Western Regional Energy Development Study.)

PUBLICATIONS: Energy Model Results and Executive Summary, Vol. I; Energy Model Results: Data Base, Vol. II. Will be available from NTIS, Springfield, VA 22161.

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PROJECT TITLE: Western Regional Energy Development Study - Socio-economic and Secondary Impacts

INVESTIGATOR/ORGANIZATION: John S. Gilmore, University of Denver Research Institute, Industrial Economics Division, 2135 E. Wesley Avenue, Denver, CO 80210, (303) 753-3207

FUNDING AGENCIES: U.S. Council on Environmental Quality, U.S. Environmental Protection Agency, U.S. Energy Research and Development Administration, U.S. National Science Foundation, U.S. Department of the Interior

FUNDING AMOUNT: \$188,477 (FY77 \$92,499)

DURATION: 7/76 - 1/78

LOCATION: Northern Great Plains and Rocky Mountain States

DESCRIPTION: The purpose of this study is to develop a methodology to assess the socio-economic impacts of Western Regional Energy Development. (This study is part of a three phase study coordinated by the Council on Environmental Quality on Western Regional Energy Development.)

PUBLICATIONS: Several working papers. Final report to CEQ at conclusion of study.

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PROJECT TITLE: Water Use and Coal Development in Eastern Montana: An Evaluation of the Potential Economic Impact

INVESTIGATORS/ORGANIZATIONS: Paul E. Polzin, Bureau of Business and Economic Research, University of Montana, Missoula, MT 59801, (406) 243-5113; Richard L. Stroup, Dept. of Agricultural Economics and Economics, Montana State Univ., Bozeman, MT 59715, (406) 994-3701

FUNDING AGENCY: U.S. Department of the Interior, Office of Water Resources Research

FUNDING AMOUNT: \$38,000

DURATION: 9/73 - 12/74 (Completed)

LOCATION: Eastern MT

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DESCRIPTION: The report describes the current economic situation in the region and the present state of development of water and coal resources. It uses alternative projections of coal development over the next ten years and estimates the economic impact of each alternative. Emphasis is placed on the effect on employment and on the economic well-being of eastern Montana residents. Concern for social and environmental impacts, but the research deals with specifically with these problems. The goal of the project was to provide reliable, useful information of the potential development of eastern Montana water and coal resources to state and local policy makers, to businessmen and the general public.

PUBLICATIONS: Paul E. Polzin. Water Use and Coal Development in Eastern Montana. November 1974. Bureau of Business and Economic Research, University of Montana, Missoula; R.L. Stroup and S.B. Townsend. Water Use and Coal Development in Eastern Montana - Water Availability and Water demands. December 1974. Dept. of Ag. Economics and Economics, Montana State University, Bozeman, MT.

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PROJECT TITLE: Impact of Colstrip Units 3 and 4 on Public Service Requirements

INVESTIGATORS/ORGANIZATION: Anne S. Williams and Donald W. Patterson, Institute of Applied Research, Montana State University, Bozeman, MT 59715, (406) 994-3835

FUNDING AGENCY: State of Montana (Dept. of Social and Rehabilitation Services)

FUNDING AMOUNT: \$23,000

DURATION: 9/73 - 8/74 (Completed)

LOCATION: MT - Rosebud County (Colstrip)

DESCRIPTION: Objectives of the study were to: (1) Identify the public service needs which would accompany construction of Colstrip Generators #3 and #4. (2) Identify the disparities (if any) between projected levels of population growth and the availability of public services; (3) Make policy recommendations to correct identified public service delivery problems. Study area included Rosebud County, Montana, and nearby service centers. Conclusion was that existing and planned public services could not adequately serve projected level of population growth that would accompany construction of the proposed generators, and that the most difficult times would occur during peak construction years.

PUBLICATIONS: Anticipated Impact of Colstrip Generators #3 and #4 on Public Services," July 1974. Institute of Applied Research, Montana State University.

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PROJECT TITLE: Assessment for Coal Slurry Pipeline Technology

INVESTIGATOR/ORGANIZATION: Brad Hollomon, Office of Technology Assessment, Congress of the United States, Washington, D.C. 20510, (202) 224-7042

FUNDING AGENCY: U.S. Congress, Office of Technology Assessment

FUNDING AMOUNT: Not easily extracted from rest of OTA program.

DURATION: 7/76 - 12/77

LOCATION: Nationwide

DESCRIPTION: The U.S. Office of Technology Assessment is performing a technology assessment of coal pipelines at the request of several committees of the House and Senate. Federal legislation to provide or foster the transportation of coal slurry by pipeline has been considered by the Congress for over 10 years and has been a subject under active deliberation since 1974. Among the legislative concerns expressed in requests for an assessment of the coal slurry pipeline technology and its relative advantages and disadvantages are questions regarding potential impacts upon the environment, potential impacts upon other possible modes of transportation, and potential impacts on the consumption of water in areas where coal mining activity is expected to increase in the coming years. The assessment is expected to include such matters as: (1) A number of technological, energy and legal issues; (2) Environmental effects with emphasis on water, land use and community planning; and (3) Evaluation of the costs, returns and impacts of slurry pipelines on the railroads. The results of the assessment will be presented in a form which clearly defines and analyzes alternative courses of action.

PUBLICATIONS: A final report will be available upon completion of the assessment.

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PROJECT TITLE: Assessment of Coal Slurry Pipeline Technology -- Economic and Competitive Impacts Study

INVESTIGATORS/ORGANIZATION: Paul S. Souder, James Cummings-Saxton, Mary Ellen Weber, General Research Corporation/International Research and Technology Corp. (jointly), 7655 Old Springhouse Road, McLean, VA 22101

FUNDING AGENCY: U.S. Congress, Office of Technology Assessment

FUNDING AMOUNT: \$162,000

DURATION: 5/77 - 11/77

LOCATION: Nationwide

DESCRIPTION: This study addresses the economic and competitive impacts of coal slurry pipelines, which have been a continuing source of concern during Congressional considerations of legislation pertaining to this technology. The specific objective is to address the issues of costs, rates, and competitive effects on other modes of transportation. The economic impacts that would arise from the widespread introduction of slurry pipelines to meet projected coal transportation needs shall be assessed, as well as the economic impacts of meeting these same needs by expanding railroads and other existing transportation modes. (NOTE:

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This study is a sub-project of Assessment for Coal Slurry Pipeline Technology, Project No. 332.)

PUBLICATIONS: Results of this work will form part of a report to be issued by the Office of Technology Assessment, U.S. Congress, Washington, D.C. 20510.

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PROJECT TITLE: Assessment of Coal Slurry Pipeline Technology -- Legal and Regulatory Study

INVESTIGATORS/ORGANIZATION: Gary Allison, Kent Frizzell, Eric Jensen, David Dale, National Energy Law and Policy Institute, University of Tulsa, School of Law, 3120 East 4th Place, Tulsa, OK 74104, (918) 939-6351

FUNDING AGENCY: U.S. Congress, Office of Technology Assessment

FUNDING AMOUNT: \$31,000

DURATION: 7/77 - 11/77

LOCATION: Nationwide

DESCRIPTION: This project deals with the legal and regulatory element of the OTA's Assessment of Coal Slurry Pipeline Technology. The specific objective is to address the issues concerning water rights, eminent domain, common carrier status, applicable provisions of the Interstate Commerce Act, and environmental protection. The existing legal systems, including relevant statutes, regulatory policies, and judicial precedents, are to be described and discussed with particular attention to contrasting the framework for coal slurry pipelines with the regulatory environment for railroads and for other similar or competing transportation modes. (NOTE: This study is a sub-project of Assessment for Coal Slurry Pipeline Technology, Project No. 332.)

PUBLICATIONS: Results of this work will form part of a report to be issued by the Office of Technology Assessment, U.S. Congress, Washington, D.C. 20510.

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PROJECT TITLE: Coal Transport Cost Study

INVESTIGATORS/ORGANIZATION: Michael Rieber and Shao Lee Soo, Center for Advanced Computation, University of Illinois at Urbana-Champaign, Urbana, IL 61801

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Mines

FUNDING AMOUNT: \$75,000

DURATION: Completed 8/77

LOCATION: Northern Great Plains and Central Appalachia

DESCRIPTION: The economics and technology of the major existing and proposed coal transport systems are compared in this study. Based strictly on detailed investment, operating, and maintenance costs for coal transport systems -- and not on freight carriers' current rates, which may cover more than actual costs -- the study showed that existing barge and rail systems, and proposed slurry

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pipeline systems can all carry coal over long distances for less than 2¢ per ton-mile. For given origins and destinations, however, determining which system or combination is the most practical depends not only on single-system costs, but also on availability of routes, compatibility between systems, unloading-reloading costs, and a host of other economic and engineering factors. The study, covering rail, barge, truck, and pipeline movement of coal from source to consumer, describes how each transport system works, and tabulates the cost elements for each system. A regional analysis is included emphasizing eastward movement of coal from the northern Great Plains and northward movement of coal from central Appalachia. Short-distance systems, used for gathering coal from individual mines, and for distributing coal from central delivery depots to individual industrial consumers, are also covered in the study. Included are conveyor belts, trucks, pneumatic pipelines, and "yellow ball" freight, a category of rail service using tracks and cars no longer fit for mainline service.

PUBLICATIONS: Michael Rieber and Shao Lee Soo. Comparative Coal Transportation Costs: An Economic and Engineering Analysis of Truck, Belt, Rail, Barge, and Coal Slurry and Pneumatic Pipelines: Volume I - Summary and Conclusions; Volume II - Unit Trains; Volume III - Coal Slurry Pipelines; Volume IV - Barge Transport; Volume V - Conveyor Belts; Volume VI - Truck Haulage; Volume VII - Pneumatic Pipelines; Volume VIII - Yellow Ball Rail. August 1977. This report will be available for public distribution from the National Technical Information Service.

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PROJECT TITLE: Environmental Impacts of Coal Transportation by Slurry Pipeline and Unit Train

INVESTIGATORS/ORGANIZATION: Michael B. Rogozen, L. Margler, M. Martz, D. Hausknecht, H. Silverman, Science Applications, Inc., 1801 Avenue of the Stars, Suite 1205, Los Angeles, CA 90067, (213) 553-2705

FUNDING AGENCY: U.S. Congress, Office of Technology Assessment

FUNDING AMOUNT: \$86,001

DURATION: 6/77 - 11/77

LOCATION: MT, ND, SD, WY, NE (Considers pipelines from Wyoming to Texas and Montana to Minnesota. Water supply from Powder River Basin groundwater.)

DESCRIPTION: Science Applications, Inc. (SAI) is currently performing for the U.S. Congress, Office of Technology Assessment, an independent, objective analysis of the environmental impacts of coal slurry pipelines and unit trains. To make the analysis as realistic as possible, hypothetical scenarios are being examined. These include shipment of various amounts of coal between 1985 and 2040, by new coal slurry pipelines or by expanded service over existing rail lines, between the following origin destination pairs: Gillette, WY. to Ft. Worth, TX; Colstrip, MT to Becker, MN and Portage, WI; Tracy City, TN to Tampa and Ft. Lauderdale, FL; and Price, UT to Barstow, CA. A major part of the Wyoming, Texas case study is a critical review of all major issues involving the Madison Formation. In case studies, along with more general research, are intended to shed light on the following environmental issues associated with coal slurry

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pipelines: pipeline system water requirements, impacts upon alternative water uses, chemical interactions between coal and water in the slurry pipeline, pipeline right-of-way revegetation, re-use alternatives and impacts, indirect air pollution emissions, energy and material requirements, spills, and alternative water sources. Issues associated with increased unit train operations are: noise, rail-highway grade crossing accidents, fires, diesel emissions, energy and material requirements and social impacts. A main objective of the study is to develop generalizable methodologies for quantifying impacts in most of these areas. (NOTE: This study is a sub-project of Assessment for Coal Slurry Pipeline Technology, Project No. 332.)

PUBLICATIONS: Results of this work will form part of a final report to be issued by the Office of Technology Assessment, U.S. Congress, Washington, D.C. 20510.

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PROJECT TITLE: Estimation of the Impacts of Mine Roads on the Water Resource and Fugitive Dust

INVESTIGATORS/ORGANIZATIONS: Alfred C. Scheer, Joe Armijo, Eric Sundberg, Civil Engineering and Engineering Mechanics Dept., Montana State Univ., Bozeman, MT 59715, (406) 994-2111; Edward R. Burroughs, Jr., USDA Forest Service, Inter-mountain Forest and Range Experiment Station, Forestry Sciences Laboratory, Box 1376, Bozeman, MT 59715

FUNDING AGENCIES: U.S. Environmental Protection Agency; U.S. Department of Agriculture, Forest Service

FUNDING AMOUNT: EPA - Approx. \$163,900; In addition, the USDA/FS has furnished funds for this project.

DURATION: 6/74 - 6/79 (EPA support since 2/76)

LOCATION: Western Coal Region

DESCRIPTION: The original overall objective was to develop a methodology for assessing the environmental impacts of transportation facilities servicing (or proposed for servicing) surface mining sites. The first task was to identify and classify the relevant transportation system characteristics. This effort culminated in the August, 1975 report cited below. Subsequently, all parties agreed to focus the study primarily on haul roads and their effects on the water resource and fugitive dust. The July 1976 report was an interim report on this phase of the project. The goal of the continuation project is to develop a methodology for assessing the environmental impacts of haul roads on the water resource and fugitive dust.

PUBLICATIONS: (1) A.C.Scheer and J.D. Armijo. Transportation Characteristics Related to Surface Environment and Mining Considerations. August 1975. (2) A.C.Scheer, et. al., Interim Report on Environmental Effects of Haul Roads. July 1976. (3) A.C.Scheer, et. al., Effects of Mine Haul Roads on the Water Resource - A Progress Report. September 1977. Montana State University, Department of Civil Engineering and Engineering Mechanics, Bozeman, MT 59715.

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PROJECT TITLE: Forest Engineering Systems for Steep Mountain Forestry

INVESTIGATOR/ORGANIZATION: R.B. Gardner, USDA Forest Service, Forestry Sciences Lab., P.O. Box 1376, Bozeman, MT 59715

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service

FUNDING AMOUNT: \$290,000 (FY77 \$5,000) DURATION: 1/73 - 6/77 (Completed)

LOCATION: MT

DESCRIPTION: Most surface mined material is hauled in large trucks, consequently, elaborate -- though poorly planned -- road systems are built to service surface mined areas. A study is being done to develop transport systems to reduce the environmental impact on forest roads. An experimental road was constructed and designed on the Coram experimental forest in the Flathead National Forest in northwestern Montana. Several years of monitoring of environmental impacts will be necessary before they can be evaluated.

PUBLICATIONS: R.B. Gardner. Some Environmental and Economic Effects of Alternative Forest Road Designs. (American Society of Agricultural Engineers, 1976 Winter Meeting, Chicago, IL. Copies available from Forestry Sciences Lab, Box 1376, Bozeman, MT 59715.

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PROJECT TITLE: Highway Needs Related to Hauling Energy Resources

INVESTIGATOR/ORGANIZATION: Paul R. DeVine, Montana Dept. of Highways, Planning and Research Bureau, Helena, MT 59601, (406) 449-2564

FUNDING AGENCY: U.S. Department of Transportation, Federal Highway Administration

FUNDING AMOUNT: \$800.00 DURATION: 12/76 - 12/76 (Completed)

LOCATION: MT

DESCRIPTION: This study is authorized by Section 153 of the 1976 Federal Aid Highway Act to obtain information concerning the possible need for construction or reconstruction of highways that may be required to transport energy resources. These resources are defined as coal, petroleum products, oil, oil shale, natural gas and uranium. Report on number of miles of roads requiring improvement and estimated costs was submitted to the Federal Highway Administration Division Office in December 1976.

PUBLICATIONS: Montana's Highway Needs Related to Hauling Energy Resources and Other Energy Induced Needs. December 1976.

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PROJECT TITLE: Measurements of the Effect of Mine-Related Roads on the Surface Water Resource

INVESTIGATORS/ORGANIZATIONS: Robert S. Johnston, USDA Forest Service, Intermountain Forest and Range Experiment Station, Forestry Sciences Lab., 860 N. 12th E., Logan, UT 84321; Edward Burroughs, Jr., USDA Forest Service, IF&RES, Forestry Sciences Lab., P.O. Box 1376, Bozeman, MT 59715

FUNDING AGENCY: U.S. Environmental Protection Agency, Cincinnati Environmental Research Center, Cincinnati, OH

FUNDING AMOUNT: FY76 20,500, FY77 \$67,200, FY78 \$56,750

DURATION: 1/76 - 6/79

LOCATION: MT, ND, WY

DESCRIPTION: The objectives of this work are to: (1) Collect data on water yield and water quality of surface runoff from mine-related haul roads; (2) Evaluate whether roads cause any other adverse effects such as peaking or stream-flow or channel erosion; (3) Correlate the effects of roads on water yield and water quality to parameters of the road; (4) Use these findings to calibrate mathematical models for estimating the effects of mine haul roads upon the water resource.

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PROJECT TITLE: Measurements of Fugitive Dust from Mine Related Roads and Its Effect on the Water Resource

INVESTIGATOR/ORGANIZATION: George Belt, School of Forestry, University of Idaho, Moscow, ID (for the USDA Forest Service, IF&RES, Forestry Sciences Lab., P.O. Box 1376, Bozeman, MT 59715)

FUNDING AGENCY: U.S. Environmental Protection Agency, Cincinnati National Environmental Research Center, Cincinnati, OH

FUNDING AMOUNT: \$76,950

DURATION: 5/76 - 12/78

LOCATION: MT, ND, WY, NM, ID, CO

DESCRIPTION: The objectives of this study are: (1) Evaluate the magnitude of the problem of fugitive dust from roads and its effect upon the water resources; (2) Describe those factors of roads, traffic, vehicle size, and climate which will affect fugitive dust; (3) Develop techniques to estimate the amount of fugitive dust from mine roads; and (4) Evaluate techniques to reduce fugitive dust.

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PROJECT TITLE: Pumpability of Coal Slurries

INVESTIGATOR/ORGANIZATION: L. Berg, Dept. of Chemical Engineering, Montana State Univ., Bozeman, MT 59715, (406) 994-2222

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FUNDING AGENCY: Burlington Northern, Inc.

FUNDING AMOUNT: \$15,000

DURATION: 1/74 - 6/75 (Completed)

LOCATION: MT

DESCRIPTION: Finely ground coal-hydrocarbon slurries were studied to determine their properties. The research was separated into two parts, and initial phase to determine if the slurries would set up under pipeline pressure conditions and a more detailed look at a crude oil-coal slurry. Brookfield and Stormer viscometers were used to measure viscosities. It was found that viscosities of most coal-hydrocarbon slurries did tend to increase after pressurization to 500 and 1000 PSIG for several weeks. However, it was felt that this viscosity increase was not severe enough to eliminate any of the liquid carriers. Rheograms obtained from a Brookfield rotational viscometer for a range of coal-crude oil slurries from 0% to 50% by weight showed four distinct rheological models. Slurries of crude oil and coal were pumped through a one-inch schedule 40 pipe to determine their flow characteristics. Various methods were used to compare the effective viscosities obtained from the pipeloop's pressure drop to the apparent viscosities measured by the Brookfield viscometer. The agreement was not good. A method derived for Bingham plastics to predict pipeline pressure drops from viscometer data was tried. Its success in predicting pressure drops was found to be limited.

PUBLICATIONS: James Blazek. M.S. Thesis. Feasibility Study of Coal-Hydrocarbon Slurries. June 1975. Montana State University, Dept. of Chemical Engineering.

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PROJECT TITLE: Transport Water Contamination in Coal-Slurry Pipelines

INVESTIGATORS/ORGANIZATION: Howard S. Peavy, William A. Hunt, P.W. Jennings, Department of Civil Engineering, Montana State University, Bozeman, MT 59715, (406) 994-2111

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$80,000

DURATION: 6/77 - 6/78

LOCATION: MT

DESCRIPTION: The purpose of this project is to determine the quantity and type of pollutants which may become suspended or dissolved in the water used as the transport media in a coal slurry pipeline. Additionally, preliminary analysis of appropriate treatment techniques which will be necessary at the pipeline terminus will be made.

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PROJECT TITLE: Water Resources Aspects of Coal Transportation by Slurry Pipeline

INVESTIGATOR/ORGANIZATION: James Moore, Water Resources Research Center, Univ. of Arkansas, Fayetteville, AR 72701, (501) 575-4954

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FUNDING AGENCIES: U.S. Department of the Interior, Office of Water Resources Technology; Univ. of Arkansas

FUNDING AMOUNT: \$109,634 (Approx. 50% USDI and 50% Univ. of Arkansas)

DURATION: 7/75 - 6/78

LOCATION: MT, WY, ND, SD

DESCRIPTION: Large quantities of low sulfur coal are located in the western part of the United States, particularly in Wyoming, Montana, and the Dakotas. Unfortunately, available water resources in these areas are limited. The increased usage of coal has resulted in increased efforts regarding coal gasification and coal liquefaction. In addition, requirements for the reclamation of strip mined land are forthcoming. In the low-sulfur coal areas of the west, the increased usage of coal conversion and reclamation of strip mined land will add a substantial burden to already stressed water resources. Three significant water resource considerations are evident concerning coal transportation by slurry pipelines. These are the water quality deterioration that can be expected from the process, the possibility of using water of low quality (municipal and industrial effluents) as the source of water for the slurry, and the treatment procedures required both at dump stations and at the receiving end of the pipeline. This research program includes all three of these major areas.

PUBLICATIONS: (1) Sermfak Sanduanruang. Ph.D. Thesis. Water Resources Aspects of Coal Transportation by Slurry Pipeline. September 1976; (2) James Moore. Water Quality Considerations in the Slurry Piping of Coal (paper presented at the Frontiers of Power Technology Conference, Oklahoma State Univ., Stillwater, OK, October 1976); (3) Annual report to USDI, Office of Water Resources and Technology.

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PROJECT TITLE: Availability of Groundwater from Aquifers in the Cretaceous and Tertiary Systems in the Fort Union Coal Region

INVESTIGATORS/ORGANIZATION: Mack G. Croft, Walter R. Scott, U.S. Geological Survey, Water Resources Division, P.O. Box 778, Room 332, New Federal Bldg., 3rd and Rosser Ave., Bismarck, ND 58501, (701) 255-4011

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Water Resources Division

FUNDING AMOUNT: \$105,000

DURATION: 7/74 - 8/77 (Completed)

LOCATION: MT, ND, SD, WY

DESCRIPTION: Proposed coal developments in the Fort Union Coal Region of the Northern Plains will be attended by substantial increases in water usage. In much of the region, the only practical source of water for domestic, stock, municipal and small-scale industrial requirements is ground water from relatively shallow aquifers in rocks of cretaceous and tertiary age. However, knowledge of these aquifers is fragmental and limited to scattered localities. A systematic and regional appraisal is required for planning, development and management purposes. Objectives: (1) Determine the location, extent, and nature of the major aquifers and confining beds in the cretaceous and tertiary systems in the Fort Union Coal Region; (2) Evaluate the occurrence, movement, and availability of ground water, including sources of recharge; and (3) Determine the chemical quality of the ground water. Approach - The investigation will be concerned mainly with the compilation, analysis, and interpretations of existing pertinent data from available sources in the states of ND, SD, WY, and MT. Major aquifers in the cretaceous and tertiary systems will be identified, described, and correlated mainly through the use of geophysical and lithologic logs. Three regional hydrogeologic sections will be prepared that will illustrate the structural and stratigraphic relationships of the major formation which, for much of the region, also will represent the lower limit of potable ground water.

PUBLICATIONS: M.G. Croft, L.O. Anna, D.W. Fisher. Geology and Ground Water Resources of Late Cretaceous and Tertiary Rocks, Fort Union Coal Region. (Report in manuscript state only.)

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PROJECT TITLE: Availability of Water from Paleozoic Rocks in Eastern Montana (MT75-049)

INVESTIGATOR/ORGANIZATION: W.R. Miller, U.S. Geological Survey, Water Resources Division, 3 N. Seventh Street, Billings, MT 59101, (406) 657-6113; George M. Pike, District Chief, USGS, WRD, P.O. Box 1696, Helena, MT 59601

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Water Resources Division

FUNDING AMOUNT: Approx. \$289,000 through 9/78

DURATION: 7/74 - 9/80

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LOCATION: Big Horn, Blaine, Carter, Custer, Daniels, Dawson, Fallon, Fergus, Garfield, Golden Valley, McCone, Musselshell, Petroleum, Phillips, Powder River, Prairie, Richland, Roosevelt, Rosebud, Sheridan, Treasure, Valley, Wibaux, and Yellowstone Counties, MT

DESCRIPTION: Large water supplies are needed for energy development in the Powder River Basin. The Madison aquifer may be capable of supplying 2-5CFS via wells, but the information is inadequate to predict where and how much the aquifer will yield or what will be the effects of development. The aquifer is deeply buried and test drilling and other testing will be expensive. So little is known about the Madison that at this time logical plans cannot be made to test and evaluate the aquifer. Objective - Evaluate the data describing the aquifer to improve the conceptual model. Test the model to refine the concepts and develop a reliable understanding of the aquifer. From this knowledge plan a drilling and testing program of the Madison aquifer for fiscal years 1976 and beyond. Approach - Predict the consequences that follow from the presently held concepts of the aquifer. Utilize the existing data to determine the validity of the consequences and modify the concepts accordingly. Evaluate the geologic, geophysical, and hydrologic techniques for obtaining and extending data; determine those techniques that appear to be the most useful for a major study. Merge the concepts with the selected techniques to develop a plan to make a major study of the Madison aquifer in FY 76 and beyond.

PUBLICATIONS: Numerous. Contact the WRD, USGS, in Billings for a list.

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PROJECT TITLE: Big Sky Mine Hydrology Studies

INVESTIGATOR/ORGANIZATION: Richard Hodder, Dept. of Animal and Range Sciences, Montana Agricultural Experiment Station, Montana State Univ., Bozeman, MT 59715, (406) 994-4821

FUNDING AGENCY: Peabody Coal Company

DURATION: 1/70 - Continuing

LOCATION: MT - Rosebud County (9.6 km south of Colstrip)

DESCRIPTION: Coalbank Coulee Hydrology - Hydrogeologic and soil water monitoring has been implemented at the Peabody Big Sky Mine to evaluate the effects of mining on the local hydrologic regime. Particular attention has been focused on a 90 hectare alfalfa field adjacent to the mine boundary in the lower Coalbank Coulee Basin. Portions of this field are subirrigated. There is some concern that mining of sub-bituminous coal from the upper portion of the watershed may alter the groundwater flow system, resulting in a water table drop sufficient to reduce production from that part of the alfalfa field in downstream alluvium. Results of the current study should prove quite useful in the prediction of effects of mining on nearby agricultural areas. Reservoir Feasibility in Spoil Materials - A second study at the Big Sky Mine pertains to the feasibility of including a reservoir in spoil materials as part of the mine's reclamation plan. Present State of Montana reclamation guidelines do not encourage such a development, largely due to the unknown effects of such an impoundment on the environment and due to a concern that a semiarid climate may not sustain a viable reservoir on spoils. In 1975 the Big Sky Mine was granted temporary permission

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to construct a reservoir within recontoured spoils under condition that the hydrologic characteristics of the reservoir be monitored for a number of years. At the end of this research period the State shall review the feasibility of this reservoir on the basis of research results.

PUBLICATIONS: Progress report due June 1978.

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PROJECT TITLE: Bull Mountains Hydrologic Reconnaissance

INVESTIGATOR/ORGANIZATION: Wayne Van Voast, Montana Bureau of Mines and Geology, 3021 6th Avenue N., Billings, MT 59101, (406) 259-9834

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Land Management

FUNDING AMOUNT: \$22,000

DURATION: 7/77 - 7/78

LOCATION: MT - Musselshell County

DESCRIPTION: The BLM manages 121,287 acres of subsurface minerals in the Bull Mountains. Because of interest in subsurface coal mining, hydrological studies to upgrade land-use planning will be conducted. The study will cover part of the mountains south and west of Roundup, consistent with a large coal deposit beneath the area. The study will include the following: (1) inventory of wells and springs; (2) water quality sampling of above; (3) determination of altitude of wells and springs, (4) summarization of available water data; (5) compilation and interpretation of data.

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PROJECT TITLE: Channel Changes in the Powder River (CR75-102)

INVESTIGATOR/ORGANIZATION: Robert H. Meade, USDI, Geological Survey, Federal Bldg., Lakewood, CO 80225, (303) 234-2320

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey

FUNDING AMOUNT: FY77 \$15,000, Prior \$10,000

DURATION: 8/75 - Indefinite

LOCATION: MT - Powder River Co., WY - Sheridan and Campbell Counties (Powder River between Arvada, WY and Broadus, MT)

DESCRIPTION: After it leaves the Bighorn Mountains, the Powder River flows in an alluvial channel. Like other alluvial channels, that of the Powder River is constantly shifting by erosion, lateral accretion, and occasional cutting off of bends. As of now, the channel of the Powder River and the rates at which it shifts have been affected very little by human activities. Rates of channel migration will be measured in the 170-kilometer reach of the Powder River between Arvada, WY, and Broadus, MT. This reach was selected because sediment loads are sampled daily at Arvada, at Moorhead, and at Broadus. Another reason for the selection of this reach is that it contains the site of a

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proposed reservoir to store water for energy development. If the reservoir is built, its effects on the river channel can be assessed from the available data.

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PROJECT TITLE: Characteristics and Potential Impact of Wastewaters from a Coal-fired Power Plant at Colstrip, Montana

INVESTIGATOR/ORGANIZATION: Duane Klarich, Billings Branch Office, Montana Dept. of Health and Environmental Sciences, Box 20296, Billings, MT 59101, (406) 252-5697

FUNDING AGENCY: U.S. Environmental Protection Agency FUNDING AMOUNT: \$19,116

DURATION: 10/76 - 12/77

LOCATION: Rosebud County (Colstrip)

DESCRIPTION: Project will determine chemical-physical nature of wastewaters from Colstrip power plant. Containment of these wastes will be examined and potential impact of these wastes on hydrologic systems will be evaluated.

PUBLICATIONS: Report to U.S. EPA at conclusion of project.

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PROJECT TITLE: Chemical and Physical Characteristics of Inflow to the Tongue River in Montana (MT75-054)

INVESTIGATOR/ORGANIZATION: Rick Hutchinson, USDI, Geological Survey, 3 7th W., Billings, MT

FUNDING AGENCY: U.S. Environmental Protection Agency FUNDING AMOUNT: \$15,400

DURATION: 8/75 - 3/76 (Completed)

LOCATION: MT - Tongue River

DESCRIPTION: During November 1975 the Tongue River Dam was closed for repairs and the discharge of the river was reduced to near-record low flow. Discharge of the stream was mainly from water in the valley alluvium and from aquifers in the coal-rich Fort Union Formation. Data collected from the project will be used to determine the amount and quality of ground-water discharge to the Tongue River between the dam, which is near the Wyoming-Montana boundary, and the mouth of the river at Miles City. Stream discharge and quality will be correlated with aquifers along the stream with the aid of aerial infrared (thermal) photography and water levels in wells. Data will then be used to refine predictive techniques of estimating the potential impacts of energy-fuels development on the hydrologic regime of the Tongue River valley and similar valleys. (NOTE: This study is a sub-project of Effects of Mining and Related Activities on the Shallow Ground Water System, Project No. 360.)

PUBLICATIONS: (1) Low Flow Measurements in the Tongue River; (2) Infrared Imagery Tongue River Dam, Brandenburg Bridge.

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PROJECT TITLE: Coal Hydrology Program

INVESTIGATORS/ORGANIZATION: Wayne Van Voast, Marvin R. Miller, Hydrology Division, Montana Bureau of Mines and Geology, Butte, MT 59701

FUNDING AGENCY: Montana Bureau of Mines and Geology (State of Montana)

DURATION: 7/75 - Continuing

LOCATION: MT

DESCRIPTION: The major objective of this program is to coordinate all the coal hydrology projects into a coherent program, to assist and supplement the other projects when needed, and to cooperate and coordinate with other investigators. Results serve to promote efficient development, utilization, and conservation of Montana's coal and underground water resources.

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PROJECT TITLE: Collection of Surface-Water and Water Quality Data in South-eastern Montana

INVESTIGATOR/ORGANIZATION: George M. Pike, U.S. Geological Survey, Water Resources Division, P.O. Box 1696, Helena, MT 59601, (406) 442-9040

FUNDING AGENCIES: U.S. Department of the Interior, Geological Survey; partial funding from the Bureau of Land Management

FUNDING AMOUNT: FY77 \$60,300; Prior \$280,000 DURATION: 7/75 - Continuing

LOCATION: Eastern Montana

DESCRIPTION: To provide basic data describing stream flow, quality of water, sediment loads, and ground water in the Northern Great Plains coal region of Montana. Interpretative studies are designed to collect and use baseline data to help predict the effects of mining or related activities on the shallow aquifers. A study of the Madison Limestone is designed to help determine the availability of water and to eventually predict the effects of developing large water supplies for industry.

PUBLICATIONS: Water Resources Investigations of the U.S. Geological Survey in the Northern Great Plains Coal Region of Eastern Montana, 1974-75. U.S. Geological Survey Open-File Report, 22 p.

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PROJECT TITLE: Column Leaching Studies of Coal Mine Spoil Material

INVESTIGATOR/ORGANIZATION: Gordon K. Pagenkopf, Dept. of Chemistry, Montana State Univ., Bozeman, MT 59715, (406) 994-4801

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$2,495

DURATION: 2/75 - 6/75 (Completed)

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LOCATION: MT - Big Horn and Rosebud Counties.

DESCRIPTION: Investigation regarding the possibilities of coal mine spoil material contributing salts to the shallow ground water.

PUBLICATIONS: Gordon K. Pagenkopf, Clarence Whitworth, Wayne Van Voast. Influence of Spoil Material on Ground Water Quality. In Energy Communications, Vol. 3, No. 2, 107-126, 1977.

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PROJECT TITLE: Community Drinking Water Supply (EPA 68-01-3590)

INVESTIGATOR/ORGANIZATION: Tom Pitts, Toups Corporation, 1966 W. 15th Street, Loveland, CO 80537

FUNDING AGENCY: U.S. Environmental Protection Agency FUNDING AMOUNT: \$50,000

DURATION: 9/75 - 12/76 (Completed) LOCATION: MT - Rosebud Co. (Colstrip)

DESCRIPTION: The present quality and adequacy of drinking water supplies for Colstrip were studied. Projections for future requirements were made.

PUBLICATIONS: Evaluation of Community Water Supplies in Energy Impact Areas. Draft Report. September 1976. Toups Corporation (Final report in preparation)

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PROJECT TITLE: Compilation of Hydrogeological Data for Southeastern Montana

INVESTIGATOR/ORGANIZATION: Marvin R. Miller, Hydrology Division, Montana Bureau of Mines and Geology, Butte, MT 59701, (406) 792-8321

FUNDING AGENCY: U.S. Environmental Protection Agency (Administered by Yellowstone-Tongue APO; Montana Bureau of Mines and Geology)

FUNDING AMOUNT: \$19,800 (EPA); \$1,800 (Bureau of Mines & Geology)

DURATION: 1/76 - 6/77 (Completed)

LOCATION: MT - Carter, Custer, Fallon, Powder River, Rosebud and Treasure Counties

DESCRIPTION: The Montana Bureau of Mines and Geology has compiled and coded all existing ground water data for southeastern Montana. The Hydrology Division is currently compiling considerable groundwater data for northern and eastern Montana. This project will supplement this endeavor and place additional emphasis and priority to the six-county area included in the Yellowstone-Tongue APO project.

PUBLICATIONS: Compilation of Hydrogeological Data for Southeastern Montana. Montana Bureau of Mines and Geology Open-File Report. A report was also submitted to the Yellowstone-Tongue APO, Broadus, Montana.

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PROJECT TITLE: A Cooperative Program to Evaluate Surface and Ground Water Problems Associated with Potential Strip Mine Sites

INVESTIGATORS/ORGANIZATION: Theodore Williams, Project Director, Dept. of Civil Engineering, Montana State Univ., Bozeman, MT 59715, (406) 994-2115. (NOTE: This is a three-state project. Lead agency is Montana State Univ, in cooperation with the Montana College of Mineral Science and Technology, University of Wyoming, University of North Dakota, and North Dakota State Univ.)

FUNDING AGENCIES: U.S. Environmental Protection Agency; States of Montana, North Dakota, and Wyoming

FUNDING AMOUNT: \$2,018,730 (FY77 \$700,000) DURATION: 7/75 - 6/78

LOCATION: MT - Big Horn County (Tanner Creek), WY - Campbell County (ARCO's Black Thunder operation near Gillette), ND - McLean County (North American lease near Underwood)

DESCRIPTION: The major objective of this project is to identify possible impacts of coal mining and development in the Northern Great Plains on the surface and ground water systems of the surrounding area. Specific objectives are: (1) Obtain an equation of balance for all water inflow and outflow in each of the three study sites, one each in MT, ND, and WY; (2) Characterize the overburden from a physical and chemical point of view as well as determine its relationship to the water coming to the surface; (3) Characterize the chemical features of the mined sites; and (4) Determine hydrologic character of spoils at active mine sites in Montana. The work is a key effort in the EPA program to assess the surface and ground water problems associated with western coal. (NOTE: The Montana sub-components of this project include studies on (1) Ground Water Quality and Soil Resistivity; (2) Geohydrology; (3) Geology; (4) Organic Chemistry; (5) Soils; (6) Overburden; (7) Trace Metals; (8) Ground Water; (9) Leaching of Coal Mine Overburden Material.)

PUBLICATIONS: Quarterly progress reports to EPA. A report to the EPA is planned for the spring of 1978. Reports from each of the sub-components of this project will be included in this publication.

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PROJECT TITLE: Determination of Existing Rights, Powder River Basin, Montana

INVESTIGATOR/ORGANIZATIONS: Ralph Saunders, Water Rights Bureau, Montana Department of Natural Resources and Conservation, Helena, MT 59601, (406) 449-3634

FUNDING AGENCY: State of Montana (Dept. of Natural Resources and Conservation)

FUNDING AMOUNT: Approx. \$160,000 annually.

DURATION: 7/73 - unknown (10 years estimate) LOCATION: MT - Powder River Basin

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DESCRIPTION: The determination of existing rights involves field investigations by staff of the Department of Natural Resources and Conservation, a search of all records of water rights and use, collection of declarations from claimants of water rights, recommendations to the court by the DNRC staff, court issuance of a preliminary decree, and final decree after hearings, if necessary. Final preparations are being made for recommendations to the court on about 1,000 to 1,100 water rights representing about 6% of the land area of the Powder River Basin. These rights recommended represent all the irrigation, stock, domestic, and other water rights established on the East Fork of the Little Powder River, Hay Creek, and Ash Creek. It is estimated that there will be eventually a total of 9,000 water rights in the Basin recommended to the district court. All indications so far -- about half of those rights -- will have been established by use.

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PROJECT TITLE: East Trail Creek Study to Assess Water Problems Associated with Reclamation of Mined Lands (MT T-058)

INVESTIGATORS/ORGANIZATION: George Pike, Bill Hotchkiss, Don Ayers, Jeff Stoner, U.S. Geological Survey, Water Resources Division, P.O. Box 1696, Helena, MT 59601, 449-5263

FUNDING AGENCIES; U.S. Department of the Interior, Bureau of Land Management, Bureau of Reclamation, and Geological Survey (A part of the Energy Minerals Rehabilitation Inventory Analysis Program - EMRIA)

DURATION: 10/76 - Uncertain

LOCATION: MT - Powder River Basin

DESCRIPTION: Problem - Before coal is put up for lease the water problems that may be associated with mining and reclamation need to be known for each site proposed for mining. The extent and degree of the water problems will be important factors in selecting the sites that will be made available for leasing. Objective - Provide the data and interpretations necessary to define the water problems that may be important during mining and reclamation and suggest alternate solutions to them. Design a monitoring system to define baseline conditions and document changes in water flow and quality associated with mining and reclamation. Develop techniques and procedures that will aid in performing future studies of this type. Approach - In conjunction with USBR, BLM, and other divisions of the USGS, drill test holes, compile and interpret geologic, hydrologic, and geophysical data to describe the hydrologic system and predict the problems. Develop digital models to relate causes and effects and to make quantitative predictions of water level changes as well as changes in flow of springs.

PUBLICATIONS: A report will be prepared describing the hydrologic system, predicting problems and mitigating measures, and describing the monitoring system.

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PROJECT TITLE: Effects of Mining and Related Activities on the Shallow Ground Water System (MT75-048)

INVESTIGATOR/ORGANIZATION: Steven Slagle, USDI Geological Survey, Water Resources Division, 3 N. 7th St. W, Billings, MT 59101, (406) 657-6113; In cooperation with U.S. Bureau of Land Management, the Montana Bureau of Mines and Geology, and the Montana Department of Natural Resources and Conservation.

FUNDING AGENCY: U.S. Department of Interior, Geological Survey, Water Resources Division

FUNDING AMOUNT: \$1,000,000 (FY77 \$298,700)

DURATION: 7/74 - 6/78

LOCATION: MT (The overall study area is in general bounded on the north by the Yellowstone, on the east by the Powder and Little Powder Rivers, on the south by Wyoming, and on the west by the Bighorn and Little Bighorn Rivers.)

DESCRIPTION: Strip mining and the related aspects of coal development can be expected to cause ground water levels and ground water quality to change. The public, industry, and government need to know the extent of change in order to take and enforce mitigating measures. Water availability and water quality need to be known in order for other agencies to evaluate alternate sources of water. Objectives: Define and understand the regional and local flow systems in aquifers above the Pierre shale. Develop a semi-quantitative conceptual model as a basis for predictive models. Develop predictive models to assess the effects of mining on water levels and the yield of wells and springs. Develop "first estimate" water quality models to predict rate and direction of movement of poor quality water from spoil banks and other sources. Utilize all of the models to evaluate and revise the data collection program. Assure that the data collection and interpretation programs meet the needs of other federal and state agencies.

PUBLICATIONS. B.P. Lewis, and R.S. Roberts. Geology and Water-Yielding Characteristics of Rocks of the Northern Powder River Basin Southeast. U.S. Geological Survey, Open-File Report 77-75, 22 p. 1977.

361

PROJECT TITLE: Effects of Surface Configuration in Water Pollution Control on Semi-Arid Mined Lands (EPA R-803079-01-0)

INVESTIGATORS/ORGANIZATION: Ingvard B. Jensen, Richard L. Hodder, D.J. Dollhoff, Dept. of Animal and Range Sciences, Montana State University, Bozeman, MT 59715, (406) 994-4821; Wayne Van Voast also collaborating on project.

FUNDING AGENCIES: U.S. Environmental Protection Agency; State share for budget is provided by mining company equipment use.

FUNDING AMOUNT: \$1,446,921

DURATION: 5/74 - 9/78

LOCATION: MT - Rosebud and Richland Counties, ND - Mercer Co, WY - Carbon and Converse Co.

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DESCRIPTION: Objectives of this study are to demonstrate the effectiveness of several surface configurations in: controlling erosion, run-off, sedimentation, and pollution of adjacent drainages; quickly producing a desirable stabilizing vegetative cover; creating an equilibrium between precipitation absorbed and soil moisture evaporated and transpired so that ground water pollution will remain minimal; producing an overall desirable reclamation design providing effective drainage, esthetics productiveness and use. Surface mined study areas ranging in size from forty to sixty acres were selected near Colstrip, MT, Savage, MT, and Beulah, ND. Intensive meteorological, surface runoff and water aquifer level monitoring will be accomplished with automatic data logging systems. Five 0.21 hectare micro-watersheds have been constructed at each area to intensively evaluate each of the five surface manipulation treatments: chiseling on raw spoils, gouging on raw spoils, chiseling on topsoil, gouging on topsoil, and dozer basins on topsoil.

PUBLICATIONS: (1) D.J. Dollhopf, I.B. Jensen, R.L. Hodder. Effects of Surface Configuration in Water Pollution Control on Semi-Arid Mined Lands. Montana Agricultural Experiment Station Research Report 114. April 1977. (2) Quarterly and annual progress reports to EPA.

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PROJECT TITLE: Estimation of Amenity Values as Opportunity Costs for Energy-Related Water Use in Montana.

INVESTIGATOR/ORGANIZATION: Richard L. Stroup, Department of Agricultural Economics and Economics, Montana State Univ., Bozeman, MT 59715, 406/994-3701

FUNDING AGENCY: U.S. Department of the Interior, Office of Water Resources Research

FUNDING AMOUNT: \$66,458

DURATION: 3/75 - 8/76 (Completed)

LOCATION: Eastern Montana

DESCRIPTION: The objectives of this study are to develop, apply and test methodologies with which to evaluate the in-stream recreation and aesthetic values of water being considered for consumption by energy conversion operations in Montana. Fulfillment of these three objectives will provide practical, conceptually sound tools for important water use decisions. This opportunity cost side of the decision question is required for completion of the analysis begun in the project "Water Use and Coal Development in Eastern Montana: Water Availability, Water Demands, and Economic Impacts," funded by OWRR.

PUBLICATIONS: R.L. Stroup, M.D. Copeland, R.R. Rucker. Estimation of Amenity Values as Opportunity Costs for Energy-Related Water Use in Montana. August 1976. Available from the Water Resources Research Center, MSU, Bozeman, MT 59715.

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PROJECT TITLE: Evaluation of Aquifers Associated with Potential Coal Development in Southeastern Montana

INVESTIGATORS/ORGANIZATION: Wayne A. Van Voast, Marvin R. Miller, Montana Bureau of Mines and Geology, Butte, MT 59701

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey

FUNDING AMOUNT: \$55,000

DURATION: 7/76 -

LOCATION: Southeastern Montana

DESCRIPTION: Installation of additional research wells. Integrated wells into monitoring program. Aquifer tests for transmissivity data. Results serve to promote efficient development of Montana's coal and underground water resources.

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PROJECT TITLE: Evaluation and Monitoring of the Hydrologic Impacts of Non-point and Point-Source Pollution of the North Fork of the Flathead River

INVESTIGATOR/ORGANIZATION: W. Mark Weber, Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana, Missoula, MT (406) 543-5850

FUNDING AGENCY: U.S. Department of the Interior, Office of Water Research and Technology

FUNDING AMOUNT: \$19,480 (FY77 \$11,000)

DURATION: 7/75 - 10/77

LOCATION: MT - Flathead County (North Fork of the Flathead River)

DESCRIPTION: The research is designed to quantify and evaluate the nonpoint pollution potential of the forested watersheds tributary to the North Fork of the Flathead River. Using the multi-watershed research methodology (cf. Striffler, 1965) sample watersheds will be selected which represent a range of the conditions being evaluated (chiefly land capability and watershed disturbance). The hydrologic phenomenon to be analyzed (discharge and sediment yield - suspended load and bed load) then become the dependent variables which are statistically related to the independent variables. Thus, using this methodology within a short sampling interval it is possible to quantitatively describe the interrelationship between sediment yield, land capability, and the degree of watershed disturbance. When the data gathering and analysis of the multi-watershed investigation are completed the results from the studied sample watersheds will be extrapolated to other unstudied watersheds in the North Fork drainage basin through the use of comparative analysis of quantitative geomorphic parameters (cf. Lustig, 1965; McPerson, 1975). In this manner a model for sediment yield of this drainage basin will be created.

PUBLICATIONS: W. Mark Weber. The Cabin Creek Pit Mine and Canadian Coal Development: What Does it Mean to Montana. (In Louis D. Hayes, ed., Federalism: The American Experience, Univ. of Montana, Bureau of Gov. Research, Pub. No. 11. 1976.)

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PROJECT TITLE: Flathead Drainage 208 Project

INVESTIGATOR/ORGANIZATION: Peter Vance, Flathead Areawide Planning Organization, Box 343, Kalispell, MT 59901

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: FY77 \$495,000

DURATION: 8/75 - 8/78

LOCATION: MT -- Flathead and Lake Counties

DESCRIPTION: The study area includes Flathead and Lake Counties, the North Fork and South Fork of the Flathead River, Flathead Lake, and numerous other streams and lakes. Eight major studies will be conducted with one directly energy-related. The North Fork Flathead Study will collect baseline data on the North Fork. With impending coal mining in the Canadian headwaters of the North Fork, this study will be helpful in identifying any future pollution sources. Oil and gas exploration and extraction is also a possibility in the North Fork area.

PUBLICATIONS. Final Water Quality Management Plan for the Flathead Area. Contact the Flathead APO Office for availability.

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PROJECT TITLE: Geochemical Survey of Waters of Western Coal Regions

INVESTIGATORS/ORGANIZATION: Gerald L. Feder, Linda Saindon, USDI Geological Survey, Water Resources Division, Denver Federal Center, Box 25046, MS 413, Denver, CO, (303) 234-2404

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Water Resources Division

DURATION: 1974 - 1978

LOCATION: MT, ND, WY, UT, NM, AZ

DESCRIPTION: The principal objective of the project is to make a reconnaissance geochemical survey of the area of energy resources in the Rocky Mountain Region and the Northern Great Plains. This project emphasizes the geochemistry of the ground waters in the Powder River and Fort Union Coal Regions. Field work in the Powder River Coal Region and most laboratory analyses have been completed. Further sampling of ground waters in the western coal regions will concentrate on establishing the extent of the geochemical similarity of waters in the remaining coal regions to those in the Fort Union and Powder River Coal Regions. Due to the similarities of lithology and structure among most of the Cretaceous and Tertiary coal regions in the Northern Great Plains and Rocky Mountain Coal Provinces, it is anticipated that the same general geochemical processes occur throughout the area. (NOTE: This study is part of Geochemical Survey of Western Coal Regions, Project No. 194.)

PUBLICATIONS: Geochemical Survey of Western Coal Regions, First Annual Progress Report (Open File Report No. 74-250, 1974); Second Annual Progress Report (1975); Third Annual Progress Report (Open-File Report No. 76-729, 1976); Fourth Annual Progress Report (Open-File Report 77-872, 1977). U.S. Geological Survey.

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PROJECT TITLE: Ground Water Analyses

INVESTIGATOR/ORGANIZATION: George Pike, Water Resources Division, U.S. Geological Survey, P.O. Box 1696, Helena, MT 59601, (406) 449-5263

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$38,000

DURATION: 6/75-3/77 (Completed)

LOCATION: Eastern Montana

DESCRIPTION: Groundwater analyses of shallow aquifers in the Tongue, Yellowstone, and Missouri River drainages will be performed. Field sampling, chemical analyses and thermal imagery is involved.

PUBLICATIONS: Water well data from McCone, Richland, Dawson, and Wibaux Counties -- includes chemical analyses.

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PROJECT TITLE: Ground Water Problems Associated with Potential Strip Mine Sites

INVESTIGATOR/ORGANIZATION: Wayne Van Voast, Montana Bureau of Mines and Geology, Billings Office, 3021 6th Avenue N, Billings, MT 59101, (406) 259-9834

FUNDING AGENCY: U.S. Environmental Protection Agency (through Montana State University)

FUNDING AMOUNT: FY77 \$45,113; Prior \$72,855

DURATION: 7/75 - 6/78

LOCATION: MT - Fort Union Coal Region south of the Yellowstone (Colstrip to Decker)

DESCRIPTION: Gather data on water flow and chemistry of selected mine spoils, develop models to simulate pre-and post-mining systems, and simulate and predict flow quantity and quality so that alternate mining and reclamation techniques may be reliably evaluated. (NOTE: This study is part of "A Cooperative Program to Evaluate Surface and Ground Water Problems Associated with Potential Strip Mine Sites," Project No. 357.)

PUBLICATIONS: (1) Montana Bureau of Mines and Geology, Bulletins 93 and 97; (2) Fort Union Coal Symposium, Volume III; (3) Hydrogeologic Conditions and Projections Related to Mining Near Colstrip, Southeastern Montana, Mt. Bureau of Mines Bulletin 102. (4) Hydrologic Aspects of Strip Mining in the Sub-Bituminous Coal Fields of Montana. In Proceedings of the 4th Symposium on Surface Mining and Reclamation, Louisville, KY October 1976; (5) Van Voast, Whitworth, and Pagenkopf, Influence of Spoil Material on Ground Water Quality. Published in Energy Communications, 3(2), pp. 107-126, 1977.

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PROJECT TITLE: Hydrogeological Reconnaissance of the Fort Union Formation

INVESTIGATOR/ORGANIZATION: Wayne A. Van Voast, Montana Bureau of Mines and Geology, Billings Office, 3021 6th Avenue N, Billings, MT 59101, (406) 259-9834

FUNDING AGENCIES: U.S. Department of the Interior, Geological Survey; Mt. Bureau of Mines and Geology

FUNDING AMOUNT: \$8,875 (USGS); \$30,000 (Bureau of Mines & Geology)

DURATION: 7/75 - 6/77

LOCATION: Eastern MT

DESCRIPTION: Well inventory south of Yellowstone River has been completed. Water quality samples from selected wells have been collected and analyzed. Field data compiled and placed on open file. Information gathered will be used to supplement and support the Montana Bureau of Mines and Geology's hydrologic studies. Results serve to promote efficient utilization and conservation of water resources of Eastern Montana.

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PROJECT TITLE: Hydrologic Characteristics of Mine Spoils

INVESTIGATOR/ORGANIZATION: Wayne Van Voast, Montana Bureau of Mines and Geology, 3021 Sixth Avenue N, Billings, MT 59101, (406) 259-9834

FUNDING AGENCY: Old West Regional Commission

FUNDING AMOUNT: \$97,400

DURATION: 6/75-6/77 (Completed)

LOCATION: Eastern MT

DESCRIPTION: Gather data on water flow and chemistry of selected mine spoils, develop models to simulate pre- and post-mining systems, and simulate and predict flow quantity and quality so that alternate mining and reclamation techniques may be reliably evaluated. Performed numerous laboratory leach experiments on mine spoils. Established the sources of salts in leachates as spoil material rather than coal. Compared quality of water from coal beds, overburden, and mine spoils and found that water in mine spoils is chemically similar to that in overburden. Conducted preliminary earth resistivity tests to develop capability of predicting post-mining ground water salt loads.

PUBLICATIONS: (1) Montana Bureau of Mines and Geology, Bull. 98 and Bull. 97; (2) Western Energy Open-File; (3) Fort Union Coal Symposium, Vol. III; (4) Polish-U.S. Symposium on Open Mine Cuts, Denver Univ., Denver, CO; (5) National Coal Assoc, 4th Symposium on Surface Mining & Reclamation, Louisville, KY

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PROJECT TITLE: Hydrologic Conditions in the Colstrip, Montana Area

INVESTIGATOR/ORGANIZATION: Wayne Van Voast, Montana Bureau of Mines and Geology, 3021 Sixth Avenue North, Billings, MT 59101, (406) 259-9834

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FUNDING AGENCY: Western Energy Company

FUNDING AMOUNT: \$65,514

DURATION: 7/73 - 6/76 (Completed)

LOCATION: MT - Rosebud Co. (near Colstrip)

DESCRIPTION: Determine and interpret current hydrologic conditions, detect any changes in water quality, artesian pressures, and stream discharge as mining and reclamation proceeds.

PUBLICATIONS: (1) Western Energy Open File Report; (2) Fort Union Coal Symposium, Vol. III; (3) Hydrogeologic Conditions and Projections Related to Mining Near Colstrip, Southeastern Montana, Montana Bureau of Mines and Geology, Bulletin 102.

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PROJECT TITLE: Hydrologic Effects of Surface Mining, Land Rehabilitation, and Land Use as Defined by Rainfall Simulation

INVESTIGATORS/ORGANIZATIONS: Richard Hadley, Gregg C. Lusby, Water Resources Division, U.S. Geological Survey, Box 25046, Denver Federal Center, Denver, CO 80225; Terrance J. Toy, Dept. of Geography, University of Denver

FUNDING AGENCIES: U.S. Department of the Interior, Geological Survey, Water Resources Division; Bureau of Land Management

FUNDING AMOUNT: USGS - \$120,000; BLM - \$140,000 DURATION: 7/73 - 9/77

LOCATION: Eleven western states

DESCRIPTION: The objectives of the study include: (1) Quantitative characterization of a variety of soil-vegetation complexes with regard to surface flow, sediment yield, and susceptibility to erosion; (2) Determination of the basic processes controlling runoff and erosion from upland areas; and (3) Determination of the effects of various types of land use. It is not the objective of this study to extrapolate directly from upland basins to larger downstream areas. It is, however, the primary objective of the study to furnish the necessary hydrologic data that will assist in regional reconnaissance studies with the purpose of estimating the environmental impacts of land use. One of the land uses to be evaluated as part of the overall study is surface mining. The present phase of the study consists of characterizing surface hydrology conditions on undisturbed sites at coal lease tracts administered by the BLM. This work is being done as part of the EMRIA program. The primary tool in attaining the objective is a rainfall simulator which applies a standard storm to about 4,000 square feet of land surface. The runoff and erosion from individual sites is then measured and compared.

PUBLICATIONS: Gregg C. Lusby, Terrence J. Toy. An Evaluation of Surface Mine Spoils Area Restoration in Wyoming Using Rainfall Simulation. In Earth Surface Processes, Vol. I. 1976.

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PROJECT TITLE: Hydrology of Coal Mine Spoils

INVESTIGATOR/ORGANIZATION: Wayne Van Voast, Montana Bureau of Mines and Geology, Billings Office, 3021 6th Avenue N, Billings, MT 59101, (406) 259-9834

FUNDING AGENCY: Montana University Joint Water Resources Research Center

FUNDING AMOUNT: \$28,000 (FY77 \$10,500)

DURATION: 6/74 - 9/77

LOCATION: Southeastern Montana

DESCRIPTION: To obtain and interpret basic data on the hydrologic character of spoils. These data are of utmost importance to augment other hydrologic research related to strip coal mining and reclamation. The data obtained will also be of value to the coal industry for application to engineering problems.

PUBLICATIONS: Montana Bureau of Mines and Geology, Bull. 93 and Bull. 97.

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PROJECT TITLE: Hydrology of the Madison Limestone and Associated Rocks in Parts of Montana, Nebraska, North Dakota, South Dakota, and Wyoming (CR76-192)

INVESTIGATOR/ORGANIZATION: Elliott M. Cushing, U.S. Geological Survey, MS 412, Box 25046, Denver Federal Center, Denver, CO 80225, (303) 234-2018 (NOTE: For the Montana portion of this study contact: William R. Miller, U.S. Geological Survey, 3 N. 7th Street, Billings, MT 59101, (406) 657-6113)

FUNDING AMOUNT: \$9,000,000 (FY77 \$2,020,000)

DURATION: 12/75 - 9/80

LOCATION: Portions of MT, NE, ND, SD, AND WY (For Montana, Powder River Basin)

DESCRIPTION: Major development of coal within the area will place a heavy demand on the area's limited water resources. Surface water is poorly distributed in time and space. It is fully appropriated in part of the area, and in the rest its use will require storage reservoirs and distribution systems. Preliminary studies indicate that the Madison Limestone (Madison Group) and associated rocks might provide a significant percentage of the total water requirements for coal development. However, the effects of large sustained waters from these rocks on the hydrologic system are not known. The objectives of the five-year hydrologic study of the Madison Limestone and associated rocks are to evaluate the quantity of water that may be available from the Madison; define the chemical and physical properties of the water; determine the effects of existing developments on potentiometric head, storage, recharge and discharge, spring flow and stream flow, and pattern of ground water flow; predict the possible hydrologic effects of proposed withdrawals of water for large-scale developments at selected rates and locations; determine the optimum locations for well and the type of construction and development of deep wells to obtain maximum yields; and design a network of observation wells and streamflow gages to monitor effects of additional developments on the hydrologic system.

PUBLICATIONS: Numerous. Contact investigator for list and for availability.

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PROJECT TITLE: Impacts of Coal Development on Water Quality of the Poplar River

INVESTIGATOR/ORGANIZATION: Abe Horpestad, Water Quality Bureau, Mt. Dept. of Health and Environmental Sciences, Helena, MT 59601, (406) 449-2406

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$20,443

DURATION: 5/75 - 2/78

LOCATION: MT - Poplar River

DESCRIPTION: Objective - To determine the impacts of coal development on the water quality of the Poplar River, Montana.

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PROJECT TITLE: Integrative Assessment - Reconnaissance Mapping of Alluvial Valleys to Define Relationships Between Mining of Shallow Coal and Competing Land Uses

INVESTIGATOR/ORGANIZATION: Jack Schmidt, for the Montana Department of Health and Environmental Sciences and the Montana Energy Advisory Council, Helena, MT 59601

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$10,000

DURATION: 7/76 - 12/76 (Completed)

LOCATION: MT - General area of McCone, Garfield, and Dawson Counties

DESCRIPTION: Objectives - To determine, through reconnaissance mapping of surface drainages in a three-county area of northeastern Montana, appropriate measures that will protect the water resources and will thus protect the water-dependent resources of agriculturally-important alluvial valleys where such valleys have potential to be affected by extractions of the coal resource; To provide a basis upon which the area of eastern Montana, underlain by surface-mineable coal, may be comprehensively assessed in terms of competing uses for land and water by expanding the mapping effort conducted in the Powder River Basin to the general area encompassed by McCone, Garfield, and Dawson Counties (Missouri River drainage). To refine the techniques of identifying alluvial valley floors.

PUBLICATIONS: Jack Schmidt. Alluvial Valley Floors in East-Central Montana and Their Relation to Strippable Coal Reserves: A Reconnaissance Report. January 1977. Submitted to the Environmental Protection Agency, Region VIII.

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PROJECT TITLE: Investigation of Possible Techniques to Predict Groundwater Quality in Mined Lands

INVESTIGATORS/ORGANIZATION: Robert Hedges, Michael Nicklin, Wayne Van Voast, Montana Bureau of Mines and Geology, Billings Office, 3021 6th Avenue N, Billings, MT 59102, (406) 657-2251

FUNDING AGENCY: U.S. Department of the Interior, Office of Water Research and Technology

FUNDING AMOUNT: \$8,500

DURATION: 10/77 - 9/78

LOCATION: Southeastern Montana

DESCRIPTION: Objectives of this project are to examine and experiment with earth-resistivity and saturated-paste data, to compare the results with existing mined-area water-quality data, and to conclude whether these or some other techniques may be usable in predicting post-mining water quality. If possible in the scope of the project, progress will be made in actual development of the predictive capability.

PUBLICATIONS: Publications will be by way of annual reports and a final report.

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PROJECT TITLE: Limnology of the Tongue River Reservoir: Existing and Potential Effects of Coal Strip Mining

INVESTIGATOR/ORGANIZATION: Richard W. Gregory, Montana Cooperative Fishery Research Unit, Montana State University, Bozeman, MT 59715, (406) 994-2450

FUNDING AGENCY: Decker Coal Company, Sheridan, WY

FUNDING AMOUNT: \$58,260 (FY77 \$16,765)

DURATION: 4/75 - 6/79

LOCATION: MT - Big Horn County (Tongue River Reservoir)

DESCRIPTION: The Decker Coal Company is presently operating a large open-pit mine adjacent to and upstream from the Tongue River Reservoir. Periodic discharges from a settling pond used to receive seep water pumped from the mine presently enter the reservoir from the southwest. Two additional mines are scheduled to be opened in 1976 or 1977 on the east and west banks of the reservoir. There is concern about the immediate and long-term effects of the mining operations and settling pond effluents on important limnological parameters of the reservoir. Nothing is presently known of the limnology of the reservoir or the potential impact of surface coal mining. Parameters listed will be measured prior to opening any new mines. Monitoring will continue during additional mining operations and subsequent reclamation to test predicted impact. Data will be correlated with concurrent fishery investigations presently underway at the reservoir. Objectives - (1) To measure and map the morphometry of the reservoir basin; (2) To prepare a nutrient budget for the reservoir by determining inflow, outflow and storage of critical chemical elements; (3) To study the effect of the settling pond effluent on the reservoir; (4) To determine the size, production, and flushing loss of phytoplankton and zooplankton populations.

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PROJECT TITLE: Microbial Sulfur Cycle Activity in Waters Associated with a Montana Coal Strip Mine.

INVESTIGATOR/ORGANIZATION: Gordon A. McFeters, Dept. of Microbiology, Montana State Univ., Bozeman, MT 59715, (406) 994-2902

FUNDING AGENCY: U.S. Department of the Interior, Office of Water Research and Technology

FUNDING AMOUNT: \$8,000

DURATION: 9/77 - 8/78

LOCATION: MT - Big Horn County (Decker)

DESCRIPTION: This study will help describe how microorganisms that are active in the sulfur cycle participate in water quality transformations of mining impacted groundwaters and surface waters. We hope to determine: (1) Why acidophilic thiobacilli, a causative agent of acid mine drainage, should be found in alkaline waters draining low sulfur coal beds at the Decker mine; (2) Whether or not these organisms are forming acid from metal sulfides in the mine; (3) If the mine settling pond is acting as a basin for the removal of heavy metals from mine waters prior to their discharge from the mine as a result of the active sulfate reducing bacteria population; and (4) If sulfate reducing bacteria are responsible for the presence of hydrogen sulfide in the groundwaters near the mine, and has mining played a role in the process? Answers to these questions would help us to predict the effects future mining would have on the water quality of mine impacted areas in Montana.

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PROJECT TITLE: Mid-Yellowstone Water Quality Management 208 Project

INVESTIGATOR/ORGANIZATION: Allen Bond, Mid-Yellowstone Areawide Planning Organization, 3300 2nd Avenue N. Suite 2, Billings, MT 59101, (406) 245-6619

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$735,000

DURATION: 12/75 - 1/78

LOCATION: MT - Big Horn, Carbon, Yellowstone, Stillwater, Sweetgrass Counties and the Crow Reservation

DESCRIPTION: From a water quality standpoint the area in this study is diverse with coal deposits and strip mining in Big Horn County, Montana's largest metropolitan area in Billings, three major oil refineries in Billings and Laurel, and a mix of rural land uses ranging from forest land in the mountainous western areas to irrigation and rangeland throughout the area. Three current land uses -- recreation, energy development, and subdivision activity -- will be studied in relation to water quality degradation. Land use policies and regulations to guide future growth and development will be developed.

PUBLICATIONS: A Water Quality Management Plan will be available at conclusion of project.

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PROJECT TITLE: Mining-Related Hydrologic Evaluations Near the Big Sky Mine, Southeastern Montana

INVESTIGATOR/ORGANIZATION: Wayne Van Voast, Montana Bureau of Mines and Geology, 3021 Sixth Avenue N., Billings, MT 59101, (406) 259-9834

FUNDING AGENCY: Peabody Coal Company

FUNDING AMOUNT: \$23,444

DURATION: 7/75 - 6/76 (Completed) LOCATION: MT - Rosebud Co. (near Colstrip)

DESCRIPTION: Gather and interpret base-line hydrologic data leading to a firm understanding of the local hydrologic system. Completed final report describing pre-mining and current hydrologic conditions and predicting hydrologic effects of further mining.

PUBLICATIONS: (1) Final report to Peabody Coal Company; (2) Hydrogeologic Conditions and Projections Related to Mining Near Colstrip, Southeastern Montana. Montana Bureau of Mines and Geology, Bulletin 102.

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PROJECT TITLE: A Model for Predicting Ion Concentrations in the Yellowstone River Basin Between Billings and Miles City, Montana: A Management Tool

INVESTIGATORS/ORGANIZATION: Richard W. Karp, Donald W. Boyd, Dept. of Industrial Engineering, Computer Science, Montana State Univ., Bozeman, MT 59715, (406) 994-3971

FUNDING AGENCY: U.S. Environmental Protection Agency FUNDING AMOUNT: \$6,500

DURATION: 9/75 - 9/76 (Completed)

LOCATION: MT - Yellowstone Basin between Billings and Miles City

DESCRIPTION: Many government agencies that are concerned with water resource management have been collecting substantial amounts of water quality data on the Yellowstone River Basin. As water quality data increases in amount, it is imperative that the data be analyzed for relationships which can be used for predictive purposes in water quality management. Such relationships can also be used to identify those parameters for which chemical analysis should be discontinued. An observation of the water quality data for the Yellowstone River indicates that relationships exist between the concentration of various ions, electrical conductivity, and quantity of flow. Similar relationships have been found for other river systems. The scope and objective of this study are: (1) To develop a model for predicting the level of various selected water quality parameters along the Yellowstone River between Billings and Miles City, Montana, from measurements of EC and Q; (2) To develop the modeling capability required to indicate incremental changes in the water quality parameters expected to occur as a result of energy-related development in the Basin.

PUBLICATIONS: Richard W. Karp. A Model for Predicting Ion Concentrations in the Yellowstone River Basin Between Billings and Miles City, Montana: A Management Tool. Masters Thesis, Montana State University, Bozeman, MT.

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PROJECT TITLE: Monitoring and Modeling of Shallow Groundwater Systems in the Powder River Basin (BOM No. J0265050)

INVESTIGATORS/ORGANIZATION: Michael A. Nawrocki, Thomas Mills, Hittman Assoc., Inc. Woodside Plaza I, Suite 122, 5500 S. Syracuse Circle, Englewood, CO 80110

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Mines

FUNDING AMOUNT: \$1,497,849

DURATION: 7/76 - 7/81

LOCATION: MT, WY - Powder River structural basin

DESCRIPTION: This project is designed to assess and predict the impacts which surface coal mining will have on the regional shallow groundwater systems in the Powder River BASin. The primary objective will be met through the accomplishment of the following: (1) The design and establishment of a regional network for monitoring of shallow groundwater systems in the Basin; (2) Monitoring of the direction and rate of flow, water quality, and aquifer characteristics of the shallow ground water systems; (3) Development of a regional groundwater simulation model, with appurtenant subroutines to determine local effects, which is capable of predicting the impacts of coal strip mining on the shallow groundwater quality and quantity will be developed by Prickett and Lonquist. The project is divided into two phases. During Phase I, which was recently completed, a literature survey was conducted to acquire the available data and to identify where additional field data is required. Then, a monitoring program was designed to gather the necessary data for development of the regional shallow groundwater model. Also during Phase I, the basic Prickett-Lonquist model was set up and run for the generalized conditions existing in the Powder River Basin in order to test overall response times, sensitivity of parameters, and general operation of the model. During Phase II, the monitoring program will be implemented and the regional model will be developed, calibrated, and tested using data acquired from the monitoring program.

PUBLICATIONS: Final Report due in 1981. Will be available from the U.S. Bureau of Mines, Denver, CO.

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PROJECT TITLE: Montana State Water Plan

INVESTIGATOR/ORGANIZATION: John Acord, Water Resources Bureau, Montana Dept. of Natural Resources and Conservation, Helena, MT 59601, (406) 449-2372

FUNDING AGENCIES: State of Montana; U.S. Water Resources Council

FUNDING AMOUNT: FY77 \$307,341 (Montana); \$62,000 (WRC)

DURATION: 7/76 - Continuing

LOCATION: MT - Statewide

DESCRIPTION: Development of a comprehensive, coordinated multiple-use water and related land resources plan for the State requires consideration of all beneficial uses of water, including water for energy production. Current planning efforts are concentrated in the Yellowstone River Basin, where large amounts of water to be used in energy production have been applied for, and

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if permitted, could seriously impact other water users. Other energy-related water planning efforts are more regional and involve cooperation with: The Corps of Engineers in evaluating hydropower and pumped storage potential; The Pacific Northwest River Basin Commission and the Missouri River Basin Commission in developing Comprehensive Coordinated Joint Plans and the National Assessment; The Western States Water Council in determining water requirements for energy in the eleven western states; and The Interstate Conference on Water Problems in suggesting guidelines for National Assessment of Water for Energy under Section 13 of PL 93-577.

PUBLICATIONS: (1) The Framework Report, Vol. I, A Comprehensive Water and Related Land Resources Plan for the State of Montana, October 1976; (2) The Flathead River Basin - A Level "B" Study of Water and Related Land Resources, September 1976; (3) Upper Flathead River Basin Study, January, 1977; (4) Supplemental Water for the Milk River, February 1977; (5) The Future of the Yellowstone River, January 1977; (6) Yellowstone River Basin - Draft EIS for Water Reservation Applications, Vol. I, II, December 1976; Final EIS, February 1977; Draft Addendum EIS, June 1977. Available from the Montana State Library.

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PROJECT TITLE: Nonpoint Source Water Quality Management

INVESTIGATORS/ORGANIZATIONS: Ray Choriki, Montana Testing Laboratory, 711 3rd Street, NW, Great Falls, MT 59404; Dana Schmidt, Olson-Elliott & Assoc., 349 Last Chance Gulch, Helena, MT 59601

FUNDING AGENCY: U.S. Environmental Protection Agency (through the Yellowstone-Tongue Areawide Planning Organization)

FUNDING AMOUNT: \$58,000

DURATION: 5/76 - 4/77 (Completed)

LOCATION: MT- Carter, Custer, Fallon, Powder River, Rosebud, & Treasure Cos., and the No. Cheyenne Reservation

DESCRIPTION: The consultant is to determine the extent of the existing non-point source water quality problems and recommend cost-effective corrective measures for those problems. Structural and nonstructural management techniques will be developed to reduce the adverse water quality impacts for future energy developments in the area. A data base and management guidelines will be developed for use by local agencies. The conservation districts will participate in the collection of data and the development of management techniques.

PUBLICATIONS: A report on this work will form part of the Yellowstone-Tongue Water Quality Management Plan. This will be available from the Yellowstone-Tongue APO, P.O. Box 503, Broadus, MT 59317

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PROJECT TITLE: Northern Cheyenne Water Quality Project

INVESTIGATOR/ORGANIZATION: William W. Woessner, Northern Cheyenne Research Project, P.O. Box 388, Lame Deer, MT 59043, (406) 477-6278

FUNDING AGENCY: U.S. Environmental Protection Agency (through the Yellowstone-Tongue Water Quality Management 208 Project)

FUNDING AMOUNT: \$50,000 DURATION: 4/76 - 8/77 (Completed)

LOCATION: MT - Northern Cheyenne Reservation

DESCRIPTION: The study will collect and interpret water quality data. Land use/water quality relationships will be investigated and management practices developed, including those concerned with energy impact in this area.

PUBLICATIONS: Final report to Yellowstone-Tongue APO, P.O. Box 503, Broadus, MT 59317

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PROJECT TITLE: Poplar River Water Quality Systems Model

INVESTIGATOR/ORGANIZATION: Abe Horpestad, Water Quality Bureau, Montana Dept. of Health and Environmental Sciences, Helena, MT 59601, (406) 449-2406

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$15,000 DURATION: 1/77 - 12/77

LOCATION: MT - Poplar River

DESCRIPTION: The basic objective of the modeling effort is the development and application of a water quality systems model for flowing waters to predict the impacts of coal-fired power generating facilities, surface mining of coal, reservoir construction and non energy-related activities or natural processes on the quality of the Poplar River and principal tributaries downstream of the U.S.-Canadian International boundary. Data inputs to the model will consider, but will not be necessarily limited to the following criteria: (1) Potential impacts of pollutants on aquatic ecosystems; (2) synergistic effects of pollutants; (3) Concentration of pollutants; (4) Interrelationship of parameters being modeled; (5) Adaptability of pollutant to modeling techniques; (6) Importance of parameter as a pollution indicator; (7) Ease of data collection. The model is to have the capability to predict source-specific impacts as well as collective impacts under a wide range of flow conditions. Emphasis will be placed on the modeling of conservative constituents such as TDS, Boron, sodium, sulfate, etc. The model is to consider ground water inflow and recharge, depletions, irrigation return flows, mine dewatering, gross non-point problems, land use, soil type, soil moisture holding capacity, stream temperature dynamics and gross analysis of the reservoir (Coronach). Model outputs will be monthly for selected points in the system including the International Boundary, the mouths of major tributaries, the Poplar River above and below tributaries and at the mouth of the Poplar River. (NOTE: This study is part of the EPA's Poplar River Study, Project No.129.)

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PUBLICATIONS: Monthly progress reports are submitted to the Montana Energy Office, State Capitol, Helena, MT 59601.

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PROJECT TITLE: Poplar River Water Use Study

INVESTIGATOR/ORGANIZATION: Orrin Ferris, Water Resources Division, Montana Dept. of Natural Resources and Conservation, 32 South Ewing, Helena, MT 59601, (406) 449-2872

FUNDING AGENCY: U.S. Environmental Protection Agency FUNDING AMOUNT: \$5,000

DURATION: 1/77 - 12/77

LOCATION: MT - Poplar River

DESCRIPTION: The objective of this effort is to: (1) Inventory the present municipal, industrial, and agricultural water users of the Poplar River; (2) Quantify Poplar River water withdrawals and returns (including amount and timing; (3) Identify irrigated lands and crop diversity in the area; (4) Identify quality requirements; (5) Estimate future Poplar River water demands including changes in uses, requirements, changes in cropping patterns, new quality requirements, and critical factors affecting uses. (Part of EPA's Poplar River Study, Project No. 129.)

PUBLICATIONS: Monthly progress reports are submitted to the Montana Energy Office, State Capitol, Helena, MT 59601.

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PROJECT TITLE: Possible Effects of Strip Coal Mining on the Hydrologic System in the Sarpy Creek Area, Southeastern Montana

INVESTIGATOR/ORGANIZATION: Wayne A. Van Voast, Montana Bureau of Mines and Geology, Billings Office, 3021 6th Avenue, Billings, MT 59101, (406) 259-9834

FUNDING AGENCY: Westmoreland Resources FUNDING AMOUNT: \$18,000

DURATION: 6/73 - 9/74 (Completed)

LOCATION: MT - Big Horn County

DESCRIPTION: To determine hydrologic conditions due to strip mining in southeastern Montana (Sarpy Creek Area). To detect any changes in artesian pressure or water quality as minimum operations proceed.

PUBLICATIONS: Wayne A. Van Voast and Robert B. Hedges. Hydrology of the Area of Westmoreland Resources Tract-3 Coal Reserves Near Sarpy Creek, Southeastern Montana. September 1974. Open File Report, Montana Bureau of Mines and Geology.

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PROJECT TITLE: Potential Impacts to Ground Water and Surface Water Quality and Quantity from Proposed Energy Development on the Northern Cheyenne Reservation, Montana

INVESTIGATORS/ORGANIZATION: William W. Woessner, Richard Monteau, Northern Cheyenne Research Project, Northern Cheyenne Tribe, P.O. Box 388, Lama Deer, MT 59043, (406) 477-6278

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$639,338 (FY77 \$275,148) DURATION: 6/75 - 6/78

LOCATION: MT - Big Horn and Rosebud Counties, Northern Cheyenne Reservation

DESCRIPTION: The Northern Cheyenne Tribe, via the Northern Cheyenne Research Project, desires to develop an in-depth knowledge of the chemical and physical character of the reservation water resources, and the interrelation of water to other resources, so that the Tribe can make formal choices in planning coal development. A three year study plan calls for: (1) Gathering and interpreting baseline data concerning the water resources and the interrelationships of these data to land, biocommunity, supply needs, and energy resources of the reservation; (2) Ascertain potential adverse chemical, physical, and economic impacts to reservation water resources from coal development; and (3) Develop a comprehensive water resources management plan that will aid present and future planning for resources exploitation.

PUBLICATIONS: Progress reports to EPA, IERL, Cincinnati, OH.

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PROJECT TITLE: The Potential of Strip Mining Fills as Underground Aquifers and Water Storage Areas in the Powder River Basin

INVESTIGATOR/ORGANIZATION: Perry H. Rahn, South Dakota School of Mines and Technology, Engineering and Mining Experiment Station, Rapid City, SD 57701

FUNDING AGENCY: Old West Regional Commission FUNDING AMOUNT: \$80,600

DURATION: 6/74 - 6/76 (Completed) LOCATION: MT, WY, SD

DESCRIPTION: The results obtained from this project will be guidelines for determining potential of stripmining fills as underground aquifers and water storage areas in the Powder River Basin. Other data to be obtained from this project shall be: (1) To establish the porosity-permeability of selected spoils; (2) To establish the composition of spoils and effects on water composition; (3) To establish the composition of the water in spoils; (4) To establish groundwater recharge, discharge and flow direction; (5) To establish potential areas where recharge of these backfilled spoils are feasible.

PUBLICATIONS: Perry H. Rahn. Potential of Coal Strip-Mine Spoils as Aquifers in the Powder River Basin. South Dakota School of Mines and Technology, June 30, 1976.

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PROJECT TITLE: Preliminary Evaluation and Development of a Plan of Study, Madison Limestone, Northern Great Plains

INVESTIGATORS/ORGANIZATION: Elliott R. Cushing, Alfred Clebsch, U.S. Geological Survey, Water Resources Division, Denver Federal Center, Lakewood, CO 80225

FUNDING AGENCIES: Old West Regional Commission; U.S. Department of the Interior, Geological Survey

FUNDING AMOUNT: \$170,000 (OWRC)

DURATION: 1/75 - 10/75 (Completed)

LOCATION: WY, MT, SD, ND, CO

DESCRIPTION: The general purpose of this study is to quantitatively assess the potential of the Madison limestone system and associated deep aquifers as a source of water for industrial use in the Fort Union region. The study is intended to provide scientifically based answers to questions such as "How much water can be pumped from the Madison Limestone and hydrologically connected rocks without (a) interfering with existing wells, (b) adversely affecting water quality in municipal and domestic wells, (c) affecting the flow of streams that cross surface outcrops of the Madison?" The objective of this project is to develop a plan of study for a quantitative investigation involving large expenditures for drilling and testing the hydraulic and hydrologic properties of the Madison Limestone and associated deep rocks. Available data from existing wells will be combined with geophysical and other data purchased from industry to plan a drilling and testing program. An intermediate step includes the preparation of a digital model of the system to serve as a guide to additional data collection and to determine relative sensitivities and hence the importance of the several types of data on which the model is based. Streamflow records will be obtained and analyzed to determine relationships between streamflow quantities and changes in potentiometric head. Samples of surface and groundwater will be analyzed so that geochemistry of the water may be used to gain a better understanding of how the flow system operates. The digital model will be recalibrated as additional data becomes available. In summary, the immediate objective of this project is to plan the major hydrologic investigation. The ultimate objective of the major investigation is to develop a sound understanding of the hydraulic and hydrologic system, backed up by reliable technical data and applied to a prediction analysis of the system that can be used for water resources development.

PUBLICATIONS: (1) W.R. Miller. Ground Water in the Madison Group in Eastern Montana. 1975; (2) F.A. Swenson, W.G. Hodson, et. al., Water in the Madison Group, Powder River, Wyoming and Montana. U.S.G.S. Folio. 1975; (3) F.A. Swenson. Possible Development of Water from Madison Group and Associated Rocks in Powder River Basin, Montana-Wyoming. No. Great Plains Resource Program. U.S. Geological Survey. 1974; (4) Plan of Study of the Hydrology of the Madison Limestone and Associated Rocks in Parts of Montana, Nebraska, North Dakota, South Dakota, and Wyoming. U.S.G.S. Open-File Report 75-631. December 1975.

393

PROJECT TITLE: Premining Hydrologic Evaluations North and East of Decker, Montana

INVESTIGATOR/ORGANIZATION: Wayne Van Voast, Montana Bureau of Mines and Geology, Billings Office, 3021 6th Avenue N., Billings, MT 59101, (406) 259-9834

FUNDING AGENCY: Decker Coal Company, Sheridan, WY FUNDING AMOUNT: \$15,698

DURATION: 7/74 - 6/75 (Completed) LOCATION: MT - Big Horn Co. (Decker)

DESCRIPTION: Part of a long range ground water monitoring program. Interpretation of data.

PUBLICATIONS: (1) Montana Bureau of Mines and Geology, Bulletins 98 and 97; (2) Fort Union Coal Symposium, Volume III.

394

PROJECT TITLE: Pre-Mining Hydrologic Evaluations in the Southern Part of the Crow Indian Reservation, Southeastern Montana

INVESTIGATOR/ORGANIZATION: Wayne Van Voast, Montana Bureau of Mines and Geology, Billings Office, 3021 Sixth Avenue N., Billings, MT 59101, (406) 259-9834

FUNDING AGENCY: Shell Oil Company FUNDING AMOUNT: \$35,720

DURATION: 10/74 - 6/76 (Completed)

LOCATION: MT - Shell Oil Coal Lease, Young's Creek area

DESCRIPTION: Maintain established observation program, expand area, and interpret data. Completed basic data compilation for project area. Installed observation wells for monitoring program. Installed stream gaging stations on major streams. Conducted low-flow surveys on all streams. Completed final report describing pre-mining hydrologic conditions and predicting effects of mining.

PUBLICATIONS: Hydrology of the Shell Oil Coal Lease, Young's Creek area, Southeastern Montana. Montana Bureau of Mines and Geology Open-File Report.

395

PROJECT TITLE: Pumpkin Creek Study to Assess Groundwater Problems Associated with Reclamation of Mined Lands

INVESTIGATORS/ORGANIZATION: George Pike, Jeff Stoner, W.R. Hotchkiss, U.S. Geological Survey, Water Resources Division, P.O. Box 1696, Helena, MT, (406) 449-5263

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Land Management

FUNDING AMOUNT: FY77 \$50,000

DURATION: 10/76 -

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LOCATION: MT - Powder River Basin

DESCRIPTION: Problem - Before coal is put up for lease the water problems that may be associated with mining and reclamation need to be known for each site proposed for mining. The extent and degree of the water problems will be important factors in selecting the sites that will be made available for leasing. Objective - Provide the data and interpretations necessary to define the water problems that may be important during mining and reclamation and suggest alternate solutions to them. Design a monitoring system to define baseline conditions and document changes in ground water flow and quality associated with mining and reclamation. Develop techniques and procedures that will aid in performing future studies of this type. Approach - In conjunction with user, BLM, and other divisions of the USGS, drill test holes, compile and interpret geologic, hydrologic, and geophysical data to describe the hydrologic system and predict the problems. Develop digital models to relate causes and effects and to make quantitative predictions of water level changes as well as changes in flow of springs. Write a report describing the hydrologic system, predicting problems and mitigating measures, and describing the monitoring system. (NOTE: This study is part of the BLM's Energy Minerals Rehabilitation Inventory and Analysis Program -- EMRIA.)

396

PROJECT TITLE: Quality of Leach Water from Montana Coal Mine Spoils

INVESTIGATOR/ORGANIZATION: Kenneth L. Temple, Dept. of Microbiology, Montana State University, Bozeman, MT 59715, (406) 994-2901

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$13,000

DURATION: 7/75 - 7/76 (Completed)

LOCATION: Eastern MT

DESCRIPTION: To survey overburden core samples from eastern Montana coal fields with reference to the toxicity of leachates from these core samples. In particular, to investigate microbially catalyzed leaching. (NOTE: This is a sub-project of Toxic Effects on the Aquatic Biota from Coal and Oil Shale Development, Project No. 112.)

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PROJECT TITLE: Regionwide Evaluation of Available Hydrologic Data: Water Resource Considerations for the Proposed Eastern Montana Coal Development

INVESTIGATOR/ORGANIZATION: Robert Curry, Dept. of Geology, Univ. of Montana, Missoula, MT 59812, (406) 243-2341

FUNDING AGENCIES: U.S. National Science Foundation, RANN; U.S. Department of the Interior, Geological Survey; Misc.

FUNDING AMOUNT: \$42,804 (NSF); \$2,000 (Other)

DURATION: 5/75 - 12/77

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LOCATION: MT - Northern Powder River Basin and some analyses in WY

DESCRIPTION: This study will collect all available surface water streamflow and water quality records from the Northern Great Plains coal region and adjacent areas of Alberta and Saskatchewan. These data are to be analyzed on a regional scale with considerations being given to interbasin and groundwater to surface-water transfers to assess: (1) What we presently know about water quantity on the Northern Great Plains; (2) What additional information we need to know to establish adequate baseline data networks and to assess availability of demanded water; and (3) How the various proposed coal resource and allied developments will impact the available water and how the availabilities of such waters will partly control the developments. A final objective of this study will be to develop regionwide data to provide input to, and interpolate between, the areas of more intensive and extensive hydrologic analysis.

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PROJECT TITLE: Shallow Groundwater Reconnaissance of Fort Union Between Yellowstone and Missouri Rivers in Montana

INVESTIGATOR/ORGANIZATION: Steven E. Slagle, USDI, Geological Survey, Water Resources Division, 3 N. 7th Street W., Billings, MT 59101

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Water Resources Division

FUNDING AMOUNT: \$16,500 DURATION: 4/75 - 4/76 (Field work completed in 1976)

LOCATION: MT - Eastern Montana between Yellowstone and Missouri Rivers

DESCRIPTION: Objective - The objective of this study is to produce and calibrate a simulation technique that projects the impact of large-scale surface mining of energy fuels in Southeastern Montana on the shallow ground-water and surface-water systems. The study involves the collection of physical and chemical data from existing wells and from springs and seeps. The effort would be directed at geographical areas where coal is most likely to be developed in the Yellowstone River Basin and the Upper Missouri River Basin near the Fort Peck Reservoir. Approach - Initial efforts will locate existing wells in the area of eastern Montana between the Yellowstone and Missouri Rivers. Field efforts will then involve final selection of representative wells and sampling. Water levels will be measured to discover gross differences in the potentiometric surface and maps will be prepared showing this surface. Modified pumping tests may be run if pumps and observation wells are available. Samples of aquifer water will be collected and analyzed. (NOTE: This project is related to Effects of Mining and Related Activities on the Shallow Groundwater System, Project No. 360.)

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PROJECT TITLE: Shallow Groundwater Study Related to Coal in Specified Areas of the Powder River Basin, Montana and Wyoming

INVESTIGATOR/ORGANIZATION: Wayne Van Voast, Montana Bureau of Mines and Geology, Billings Office, 3021 6th Avenue N., Billings, MT 59101, (406) 259-9834

FUNDING AGENCIES: U.S. Environmental Protection Agency, U.S. Department of the Interior, U.S. Department of Agriculture (through the Northern Great Plains Resources Program)

FUNDING AMOUNT: \$28,000

DURATION: 1/75 - 6/74 (Completed)

LOCATION: MT, WY (Powder River Basin)

DESCRIPTION: Shallow groundwater study related to coal in specified areas of the Powder River Basin, Montana and Wyoming.

PUBLICATIONS: (1) Montana Bureau of Mines and Geology, Bulletins 93 and 97; (2) Fort Union Coal Symposium, Volume III.

400

PROJECT TITLE: Site Studies to Assess the Groundwater Problems that May Affect Reclamation of Mined Lands

INVESTIGATORS/ORGANIZATION: W.R. Hotchkiss, USDI Geological Survey, Water Resources Division, Box 1696, Helena, MT 59601, (406) 449-5263; Jeff Stoner, USGS, Water Resources Division, 3 N. 7th St. W, Billings, MT 59101, (406) 657-6113

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Land Management

FUNDING AMOUNT: FY77 \$99,706; Prior \$95,506

DURATION: 7/74 - Continuing

LOCATION: Southeastern MT - Tongue and Powder River drainages

DESCRIPTION: Problems of mined-land reclamation and possible solutions must be known before areas underlain by federally owned coal will be recommended for leasing. These problems range from what type of surface treatment is best to what will be the effect of surface treatment to what will be the effect of surface mining on the water resources. The principal objective of the study is to provide the data and interpretations necessary to predict the potential water-resources problems related to mining and reclamation and to suggest alternative solutions to the problems. Concurrently, a monitoring system is needed to define baseline conditions and to document changes in groundwater flow and quality caused by mining and reclamation. Site studies are underway at the following areas in southeastern Montana: Otter Creek, Bear Creek, Pumpkin Creek, and Hanging Woman Creek. All studies are listed separately.

PUBLICATIONS: EMRIA Reports Number 1 and 8.

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PROJECT TITLE: Statewide 208 Water Quality Management Plan

INVESTIGATOR/ORGANIZATION: Don Willems, Water Quality Bureau, Montana Dept. of Health and Environmental Sciences, Helena, MT 59601, (406) 449-2406

FUNDING AGENCIES: U.S. Environmental Protection Agency; State of Montana

FUNDING AMOUNT: \$540,000 (EPA); \$180,000 (State of Montana)

DURATION: 7/76 - 11/78

LOCATION: MT - Statewide

DESCRIPTION: Objectives - (1) Inventory existing sources of pollution and land and water uses; (2) Further assess water quality in priority areas; (3) Coordinate program with land management and regulatory agencies, designated area 208 agencies, and statewide sediment control project; (4) Provide public participation throughout the program; (5) Determine water pollution control needs for existing sources and potential sources of pollution; (6) Determine cost of administration and implementation; (7) Recommend law and regulation changes to implement a feasible program; (8) Assess the environmental impact of proposed program.

PUBLICATIONS: Periodic progress reports to EPA.

402

PROJECT TITLE: A Study to Evaluate Potential Physical, Biological, and Water Use Impacts of Water Withdrawals and Water Development on the Middle and Lower Portions of the Yellowstone River Drainage in the State of Montana

INVESTIGATOR/ORGANIZATION: Bob Anderson, Water Resources Division, Montana Department of Natural Resources and Conservation, Helena, MT 59601, (406) 449-2872

FUNDING AGENCY: Old West Regional Commission

FUNDING AMOUNT: \$688,263

DURATION: 6/74 - Summer 1978

LOCATION: MT - Middle and Lower portions of the Yellowstone River Drainage

DESCRIPTION: In addition to the broad objective specified in the project title, there are three sub-objectives: (1) To refine, calibrate, and evaluate a surface water flow model with attention to the model's utility as a regional prototype; (2) To acquire data which relates the surface flow parameters of the model to impacts on selected water uses; (3) To quantify, in so far as possible, the economic values and costs of various degrees of water consumption, with attention to conflicts and tradeoffs associated with foreseeable water use configuration. Impacts on the following will be assessed: (a) Aquatic communities, including game and forage fish and invertebrates, with emphasis on the Tongue River Basin; (b) Migratory birds, including geese, ducks, bald eagles, and great blue herons; (c) Riparian furbearing mammals, including beaver, muskrat, mink, and river otters; (d) Irrigated agriculture, both extant and potential; (e) Existing and future municipal and non-energy industrial water supplies; (f) Water quality; (g) Water-based recreation; (h) Channel processes and dynamics.

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PUBLICATIONS: (1) R.L. Anderson. A Study of the Impacts of Reduced Stream-flows in the Middle and Lower Yellowstone Basin. In proceedings of the Fort Union Coal Field Symposium, Billings, MT, April 25-26, 1975; (2) R.L. Anderson. Water Availability in the Yellowstone Basin, Montana. Presented at the Annual Meeting, American Association for the Advancement of Science, Boston, MA. 1976; (3) R.L. Anderson and J.L. Thomas. Water-Energy Conflicts in Montana's Yellowstone River Basin. Water Resources Bulletin 12(4): 829-842, August 1976; (4) A series of 11 technical reports on each aspect of this study, and a final summary report will be issued at conclusion of project.

403

PROJECT TITLE: Study of Ground Water Resources of Shallow Aquifers in the Poplar River Basin of Montana

INVESTIGATOR/ORGANIZATION: George Pike, U.S. Geological Survey, Water Resources Division, P.O. Box 1696, Helena, MT 59601, (406) 449-5263

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$35,000

DURATION: 3/77 - Continuing

LOCATION: MT - Poplar River Basin

DESCRIPTION: The major goal of this effort includes a detailed- and reconnaissance-level hydrological study in the Poplar River area of northeast Montana. This study is necessary so that a thorough understanding may be gained of the extant shallow ground water system and the relationship of surface waters with such systems. Moreover, the effort will serve to establish baseline quality and quantity conditions for such shallow ground waters and also to implement a ground water monitoring system. In order to achieve the principal goals of the effort, specific objectives and sub-objectives of the study include the following: (1) Establish baseline ground water conditions in defined study area(s) prior to mining or power generation; (2) Design and implement a ground water monitoring system capable of detecting changes in the ground water system attributable to mining and power generation; (3) Establish and maintain close cooperation with Canadians performing ground water studies in the Poplar River Basin. (NOTE: This project is part of the EPA's Poplar River Study, Project No. 129.)

PUBLICATIONS: Periodic progress reports to EPA, Region VIII.

404

PROJECT TITLE: Study and Monitoring of Fort Union Basin - Water Quality

INVESTIGATOR/ORGANIZATION: Don Willems, Water Quality Bureau, Mt. Dept. of Health and Environmental Sciences, Helena, MT 59601, (406) 449-2406

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$58,045

DURATION: 6/75 - 3/78

LOCATION: Eastern Montana (not Colstrip)

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DESCRIPTION: Four projects will be undertaken by the Montana Department of Environmental Sciences via funding of this project. Water quality analyses will be performed on the Poplar River for chemical, biological and metal analyses. Secondly, a fish tagging study will be performed by EPA in conjunction with the State on the Poplar. Third, the Water Quality Bureau will provide onsite assistance to an EPA contractor regarding water quality modeling. Finally, water quality analyses will be performed on the Tongue River and the Tongue River Reservoir.

PUBLICATIONS: Reports on each aspect of this study will be submitted to EPA.

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PROJECT TITLE: Surface Water Quality Monitoring in the Poplar River System

INVESTIGATOR/ORGANIZATION: George Pike, U.S. Geological Survey, Water Resources Division, P.O. Box 1696, Helena, MT 59601, (406) 449-5263

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: FY77 - \$25,000

DURATION: 3/77 - Continuing

LOCATION: MT - Poplar River Basin

DESCRIPTION: The objective of this study is to continue monitoring surface water quality in the Poplar River system of Montana. This action was initiated to more precisely define the existing conditions in the river system prior to proposed Canadian energy development. Water quality monitoring stations will be sampled monthly for field, chemical and nutrient parameters and quarterly for metals. (NOTE: This project is part of EPA's Poplar River Study, Project No. 129.)

PUBLICATIONS: Periodic progress reports to EPA.

406

PROJECT TITLE: Surface Water Quality Monitoring in the Yellowstone River and Its Tributaries in Northern Great Plains Coal Region of Eastern Montana

INVESTIGATOR/ORGANIZATION: Grady L. Moore, George M. Pike, U.S. Geological Survey, Water Resources Division, P.O. Box 1696, Helena, MT 59601, (406) 449-5263

FUNDING AGENCY: U.S. Environmental Protection Agency

DURATION: 4/74 - continuing

LOCATION: Eastern MT - Yellowstone & tributaries

DESCRIPTION: Objective - The objective of this study is to continue the surface water quality monitoring program established with the USGS in 1974. Due to variation in climatic conditions it is necessary to continue the monitoring effort for a period of years to establish representative baseline conditions. This is accomplished in part by the continuation of the previously established 8-station monitoring network to provide a more objective basis for evaluating

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the possible impacts of energy development activities on surface water quality in the Yellowstone River coal region of eastern Montana. It should be noted that there are many other water quality stations established in the area and that the EPA-USGS program is an integral part of the overall water quality sampling network. Approach - The USGS will be responsible for the collection and analysis of surface water quality data in energy impacted areas of Montana.

Progress - Collection of the agreed upon data is continuing at seven stations on the Yellowstone River and a station on the Tongue River below Hanging Woman Creek.

407

PROJECT TITLE: Upper Flathead River Basin Study

INVESTIGATORS/ORGANIZATION: Hanley Jenkins, II, Orrin Ferris, Water Resources Division, Montana Dept. of Natural Resources and Conservation, 32 South Ewing, Helena, MT 59601, (406) 449-2872

FUNDING AGENCY: State of Montana (Mt. Dept. of Natural Resources and Conservation)

FUNDING AMOUNT: \$47,500

DURATION: 9/75 - 1/77 (Completed)

LOCATION: MT - Upper Flathead River Basin above outlet of Flathead Lake

DESCRIPTION: In response to House Bill 622 (Montana Legislative Session, 1975) this study was designed to compile and analyze all biophysical data pertinent to the hydrology and limnology of the upper portion of the Flathead River drainage basin; estimate current allocations and levels of need for water resources of this watershed and evaluate probable effects that existing water uses have upon the quality and quantity of water as well as the biophysical equilibrium of the land-stream-lake system; evaluate the probable impact upon this system of the development of Canadian Cabin Creek coal deposits (Cabin Creek is a tributary of the North Fork Flathead River just north of the U.S. border in Canada) and the attendant urbanization of this headwaters region; and prepare a summary report and recommendations for the future.

PUBLICATIONS: Upper Flathead River Basin Study. Water Resources Division, Montana Dept. of Natural Resources and Conservation, Helena, MT. January 1977.

408

PROJECT TITLE: Vigil Network Establishment for the Region of the Proposed Eastern Montana Coal Development

INVESTIGATOR/ORGANIZATION: Mark Weber, Montana Forest and Conservation Experiment Station, School of Forestry, Univ. of Montana, Missoula, MT 59801

FUNDING AGENCY: U.S. National Science Foundation, RANN

FUNDING AMOUNT: \$32,000

DURATION: 5/75 - 4/76 (Completed)

LOCATION: Eastern MT

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DESCRIPTION: Vigil Network establishment consists of mapping both planimetrically and in cross section, representative reaches of rivers; establishing peak flood gages where not present, and assessing the present biotic state of those rivers with respect to benthic fauna and stream-bank flora. It is anticipated that about 50 carefully chosen vigil network stations should be established for the Eastern Montana coal region to allow for regional variability in precipitation frequency and intensity, geologic substrate variation and the full range of possible land-use variables. A second phase of the investigation of selected watersheds will be conducted to more fully evaluate the area-wide, dynamic equilibrium-disequilibrium relationships as they now exist. Such collections of base hydrographic data are extremely useful to monitor and assess effects of land use change and this factor may be related by regression analyses, to each component of that overall hydrographic change. (NOTE: This project is part of "The Impact of Coal Development in the Fort Union Basin, Montana and Neighboring States," Project No. 141.)

PUBLICATIONS: Final report to NSF-RANN.

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PROJECT TITLE: Vigil Site Study of the Yellowstone River and Its Tributaries

INVESTIGATOR/ORGANIZATION: Robert R. Curry, Department of Geology, University of Montana, Missoula, MT 59801, (406) 243-5511

FUNDING AGENCY: State of Montana (Mt. Dept. of Natural Resources and Conservation)

FUNDING AMOUNT: \$10,000 DURATION: 10/74 - 12/76 (Completed)

LOCATION: MT - Yellowstone River Basin

DESCRIPTION: This project is part of the comprehensive study of the impact of coal development on water resources in the Yellowstone River Basin. The study consists of the following items: (1) Review, remap where necessary, and substantiate existing Vigil net sites that are determined to be well selected, well established, adequately benchmarked and legally accessible; (2) Expand inventory base at existing vigil network sites that were established in Spring, 1973, so that 20 or more sites are prepared for documentation of changes in stream biota at select seasons, bed sediment size distribution, and channel geometry; (3) Rephotograph Spring, 1973, sites from photo vigil points to establish seasonal changes in vegetation dominance; (4) Survey or resurvey (all) selected vigil net sites in the first year field work periods(s) for channel geometry, sediment size class represented on bar surfaces or bed, and benthic biota; (5) Obtain rights to revisit vigil sites where necessary and secure sites liable to destruction or alternation by livestock or man; (6) Reduce and plot all vigil net stations in standard USGS format and prepare two copies on each site file; (7) Distribute data station files after preparation and reproduction; (8) Locate problem watersheds and reaches that are close to disequilibrium and may therefore be worth special effort to preserve biota.

PUBLICATION: Final report submitted to the Montana Dept. of Natural Resources, Helena, MT 59601.

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PROJECT TITLE: Water Conservation on Rangelands and Mine Spoils of the Northern Plains

INVESTIGATOR/ORGANIZATION: Frank Rauzi, U.S. Agricultural Research Service, University of Wyoming, Box 3354, Laramie, WY 82071, (406) 766-5239

FUNDING AGENCY: U.S. Department of Agriculture , Agricultural Research Service

FUNDING AMOUNT: \$38,000 DURATION: 8/70 - 9/77 (Field work completed)

LOCATION: MT, WY, ND, SD

DESCRIPTION: Objectives - Develop methods and systems for maximizing water conservation for plant use on rangelands and mine spoils. Approach - The response of introduced grasses and legumes to changes in soil water as affected by snow trapping, controlling snow melt, and the prevention of runoff on level benches will be determined on rangeland and mine spoils. Surface and subsoil properties of selected mine spoils will be characterized and appropriate soil modifications studied to optimize plant establishment and growth. Changes in yield and composition of native pastures resulting from fertilization, strip spraying with a non-selective herbicide and reseeding with adapted species in the sprayed strip will be assessed.

PUBLICATIONS: Numerous. Contact investigator for more information.

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PROJECT TITLE: Water for Energy in the Northern Great Plains Area With Emphasis on the Yellowstone River Basin

INVESTIGATOR/ORGANIZATION: Kenneth O. Kauffman, Water for Energy Management Team, U.S.D.I., Bureau of Reclamation, P.O. Box 25007, Denver Federal Center, Denver, CO 80225 (Other agencies involved in this project are: U.S. Geological Survey, Office of Water Research and Technology, Bureau of Mines, Bureau of Outdoor Recreation, Bureau of Land Management, Fish and Wildlife Service, and the Bureau of Indian Affairs)

FUNDING AGENCY: U.S. Department of the Interior

FUNDING AMOUNT: Expenses absorbed through general accounts of each of the participating agencies within USDI.

DURATION: 9/74 - 1/75 (Completed) LOCATION: MT, WY, ND, SD

DESCRIPTION: The Northern Great Plains area, encompassing 63 counties in Wyoming, Montana, North Dakota, and South Dakota, is generally within the Upper Missouri River Basin. The area, with major deposits of strippable coal, is experiencing national interest relative to the present energy problems. The conversion of coal to electricity or synthetic gas is intricately linked to water supplies. Numerous investigations and studies have been done by state, federal, and private organizations. One of the more encompassing studies is the Northern Great Plains Resource Program, a state-federal effort to develop information regarding resources and resource needs for the area. That study has been the basis for much of

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the water supply information for presentations in this report. This analysis has been prepared to serve as an important guideline for determining future policy on energy water issues. It has been prepared by the Department of Interior's Denver-based management team which was organized under the Assistant Secretary for Land and Water Resources. The basic purpose of the management team is to provide factual basis for secretarial decisions on water aspects of energy development. Specifically it is charged with making concise presentations of information and data on the alternative water supplies for specific energy development sites. Environmental aspects, inter-state water compacts, state water rights, and other pertinent conditions are all to be considered in the team's efforts. This information will assist management officials in making decisions on site-specific energy development.

PUBLICATIONS: Report on Water for Energy in the Northern Great Plains With Emphasis on the Yellowstone River Basin. U.S. Department of the Interior, Water for Energy Management Team. January 1975. Also, Report on Water for Energy in the Upper Colorado River Basin, USDI, WFE Management Team, July 1974.

412

PROJECT TITLE: Water Quality and Biological Monitoring Program for Energy Resource Areas -- Montana (OEA-75-2A-1-2A-2)

INVESTIGATOR/ORGANIZATION: George Pike, U.S. Geological Survey, Water Resources Division, P.O. Box 1696, Helena, MT 59601, (406) 449-5263

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: FY77 \$42,950; Prior \$35,550 DURATION: 4/75 - Continuing

LOCATION: MT - Yellowstone and Tongue River Basins

DESCRIPTION: Collection of baseline water quality and biological monitoring data for energy resource areas in the Yellowstone and Tongue River Basins. 8 stations.

PUBLICATIONS: Data will be available from the EPA Storet Data Storage and Retrieval.

413

PROJECT TITLE: Water Quality Effects of Coal Developments on the Tongue River Reservoir

INVESTIGATOR/ORGANIZATION: Abe Horpestad, Water Quality Bureau, Montana Dept. of Health and Environmental Sciences, Helena, MT 59601, (406) 449-2406

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$24,831 DURATION: 5/75 - 2/78

LOCATION: MT - Tongue River Reservoir

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DESCRIPTION: This project will gather basic limnological data on the Tongue River Reservoir. It is being done in cooperation with Montana State University. These studies will determine: nutrient and trace metal backgrounds, levels and sources, phytoplankton abundance and diversity, primary production. The concentration of nutrients in the sediment, and the concentration of trace metals in sediment and fish flesh will also be determined. Limiting nutrients will also be determined using algae assays.

PUBLICATIONS: Final report to EPA at conclusion of project.

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PROJECT TITLE: Yellowstone Basin and Adjacent Coal Area Level B Study: Montana, Wyoming, North Dakota

INVESTIGATOR/ORGANIZATION: Martin H. Oleson, Jeffrey White, Missouri River Basin Commission, Transwestern Life Building, Room 332, 404 N. 31st, Billings, MT 59101, (406) 657-6715

FUNDING AGENCY: U.S. Water Resources Council, Missouri River Basin Commission

FUNDING AMOUNT: \$2,000,000

DURATION: 6/75 - 2/78

LOCATION: MT, WY, ND (Yellowstone River Basin)

DESCRIPTION: The Yellowstone River Basin and Adjacent Coal Area Study is a reconnaissance investigation to provide a multiagency, interdisciplinary water and related lands study to project and evaluate alternative future developments based upon the principles and standards for water resource development developed by the Water Resource Council. The study will concentrate on the conflicts and tradeoffs between depletive water uses such as energy and irrigated agriculture and non-depletive uses such as instream flow, improved management, water quality enhancement, recreation, etc. One of the primary responsibilities of this study will be the evaluation of alternative energy futures for the study area and their interrelationship with national energy requirements.

PUBLICATIONS: Numerous. Contact the investigator for more information.

415

PROJECT TITLE: Yellowstone-Tongue Water Quality Management Project (EPA 208 Study)

INVESTIGATORS/ORGANIZATION: Tom Demaree, Ambrey Gartner, Dorel Hunt, Yellowstone-Tongue APO, Box 503, Broadus, MT 59317, (406) 436-2802

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: FY77 \$340,000; Prior \$200,000

DURATION: 8/75 - 2/78

LOCATION: MT - Carter, Custer, Fallon, Powder River, Rosebud, and Treasure Counties, and the Northern Cheyenne Indian Reservation

415 CONT.

DESCRIPTION: The Water Quality Management Project is funded under Section 208 of P.L. 92.500. Most of the effort will be directed toward utilizing existing data for planning purposes, but some new data will be collected. Consultants and government agencies will be given contracts to develop sewage treatment facilities plans, groundwater maps, land use maps, nonpoint source water quality data, and information on land use/water quality relationships.

PUBLICATIONS: Numerous reports in various stages of completion. A final water quality management plan will be finished in early 1978. Write to the YTAPO for a publications list.

COAL

1.12 OTHER

COAL/Other

416

PROJECT TITLE: Archaeological Services, Pacific Power and Light Company Lands, Decker, Montana

INVESTIGATOR/ORGANIZATION: Dee C. Taylor, Department of Anthropology, University of Montana, Missoula, MT 59801, (406) 243-5921

FUNDING AGENCY: VTN, Engineers, Architects, Planners, Denver, CO

FUNDING AMOUNT: \$14,258 DURATION: 7/76 - 2/77 (Completed)

LOCATION: MT - Big Horn County (Decker)

DESCRIPTION: From the contractor's point of view the object of the archaeological services is to provide compliance with several Federal regulations which require inventory and recovery of cultural resources prior to disturbances of land surfaces. For the archaeologist the contract provides opportunity to recover and reconstruct patterns of past human activity within specified area and to establish relationships to other areas throughout time. The archaeological services may be divided into three phases: (1) Survey, inventory, enumeration and description of archaeological sites, collection of surface cultural materials with limited sub-surface testing; (2) Testing - On the basis of (1) and planned mining activities some sites are selected for sub-surface testing to determine the nature and extent of cultural materials present; (3) Excavation of selected sites if they cannot be preserved. Complete destruction and attempt to recover all cultural data. The contract with VTN was for the first two phases.

PUBLICATIONS: Richard A. Fox. Archaeology of the Spring Creek Mine Area: Survey and Testing Phases. Prepared by the Department of Anthropology, University of Montana, 1977. Copies to: VTN, U.S. Bureau of Land Management, and the National Park Service.

417

PROJECT TITLE: Color Infrared Archaeological Study

INVESTIGATOR/ORGANIZATION: Robert E. Carroll, Ecological Consulting Service, 1300 Cedar, Helena, MT 59601, (406) 442-4650

FUNDING AGENCY: Econ, Inc. Ecological Consulting Service, Helena, MT

DURATION: 3/76 - 1977 LOCATION: MT - various sites

DESCRIPTION: A study to determine the smallest scales of vertical aerial photography at which certain archaeological manifestations may be discriminated at various seasons. Information from this in-house study will be used as a reference for future energy developments.

COAL/Other

418

PROJECT TITLE: Colstrip Area Radioactivity in Coal

INVESTIGATOR/ORGANIZATION: L.L. Lloyd, Montana Dept. of Health and Environmental Sciences, Helena, MT 59601, (406) 449-3454

FUNDING AGENCY: State of Montana

FUNDING AMOUNT: \$27,100

DURATION: 7/74 - 9/75 (Completed)

LOCATION: MT - Rosebud Co. (near Colstrip)

DESCRIPTION: Objective - To determine baseline radioactivity in air, soil, vegetation, and water. Also to measure concentrations of natural radionuclides in the coal. This information is necessary to measure any increase in baseline radioactivity resulting from the mining of coal and the operation of the Colstrip power plants.

PUBLICATIONS: Data contributed to the Montana Department of Natural Resources for their drafting of the Colstrip Generating Plants III and IV Environmental Impact Statement.

OTHER ENERGY SOURCES

2.1 OIL AND GAS

OTHER ENERGY SOURCES/Oil and Gas

419

PROJECT TITLE: Alaska Natural Gas Transportation System -- Environmental Impact Statement

INVESTIGATOR/ORGANIZATION: O.J. Ferrians, Jr., U.S. Geological Survey, Bureau of Alaskan Geology, 345 Middlefield, Menlo Park, CA 94025

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey

FUNDING AMOUNT: \$966,110 DURATION: 7/74 - 3/76 (Completed)

LOCATION: Yukon and Northwest Territories, Alberta, British Columbia, Saskatchewan, AK, ID, OR, CA, NV, WA, MT, ND, SD, MN, IA, WI, IL, IN, OH, PA

DESCRIPTION: The primary objective of this project is the preparation of a major part of the consolidated environmental impact statement for the proposed systems for transporting Alaskan natural gas from Prudhoe Bay to market in the coterminous United States. The proposed prime route and alternative routes are being assessed. For the Canadian parts of the routes, all sections of the EIS are being prepared. For the Alaskan parts, sections describing the existing environment and evaluating the environmental impacts of the proposed action in regard to geology, hydrology, permafrost, seismicity, and active faults are being prepared.

PUBLICATIONS: Final Environmental Impact Statement, Alaska Natural Gas Transportation Systems (Alaska, Canada and Glossary Volumes). 1976. U.S. Department of the Interior. Available from the Superintendent of Documents, U.S. Govt. Printing Office, Washington, D.C. 20402.

420

PROJECT TITLE: Annual Oil Reserve Estimate for the State of Montana

INVESTIGATOR/ORGANIZATION: Judson D. Sweet, Board of Oil and Gas Conservation, Montana Dept. of Natural Resources and Conservation, 15 Poly Drive, Billings, MT 59101, (406) 252-5109

FUNDING AGENCY: State of Montana (Board of Oil and Gas Conservation)

FUNDING AMOUNT: Approx. \$2,500/year DURATION: Continuing

LOCATION: MT - Statewide

DESCRIPTION: Annual reserves estimates of oil for the State of Montana are made by the State Petroleum Engineer at the direction of the Oil and Gas Conservation Board. For the most part these reserves are based on decline curves using the constant percentage decline method. In new fields, volumetric methods are used and determine reserve estimates. The reserve estimate is initiated each year when final production figures for the prior year become available, usually around the middle of February. Work on the reserve estimates is sandwiched between other routine duties of the petroleum engineer as time permits.

PUBLICATIONS: Annual reviews are published yearly. Available from the Oil and Gas Commission.

OTHER ENERGY SOURCES/Oil and Gas

421

PROJECT TITLE: Bob Marshall Wilderness: A Mineral Resource Evaluation of the Wilderness and Adjacent Study Areas

INVESTIGATOR/ORGANIZATION: Melville R. Mudge, U.S. Geological Survey, Geologic Division, P.O. Box 25046, MS 905, Denver Federal Center, Denver, CO 80225

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey

DURATION: Completed LOCATION: MT - Bob Marshall Wilderness and adjacent study areas

DESCRIPTION: A mineral resource investigation of the Bob Marshall Wilderness and adjacent study areas.

PUBLICATIONS: (1) Petroleum Evaluation of the Bob Marshall Wilderness and Adjacent Study Areas, Lewis and Clark, Teton, Pondera, Flathead, Lake, Missoula, and Powell Counties, Montana. U.S. Geological Survey Open-File Report 77-542, 1977; (2) Open-File Report anticipated to be available 2/78. Available from the Montana Bureau of Mines and Geology, Butte, MT 59701, and the U.S.G.S., Conservation Division, P.O. Box 2550, Billings, MT 59103.

422

PROJECT TITLE: Characterization of Natural Gas Resources in Low-Permeability Reservoirs of Northern Great Plains (ERDA 9410-11911)

INVESTIGATORS/ORGANIZATION: Dudley D. Rice, C.W. Spencer, U.S. Geological Survey, Geologic Division, Box 25046, MS-951, Denver Federal Center, Denver, CO 80225, (303) 234-4167

FUNDING AGENCY: U.S. Energy Research and Development Administration

DURATION: 10/76 - 10/81 LOCATION: MT, ND, SD

DESCRIPTION: With the increasing demand for energy resources in the United States, exploration must be directed toward subeconomic resources. Recent resource estimates have indicated that major gas accumulations are entrapped in tight reservoirs in the Rocky Mountain Region. To date, most studies have focused on recovery technology. Basic geological studies, such as the one initiated, have not been done, but will aid stimulation and recovery research plus help in obtaining more accurate resource estimates. The purpose of this project is to characterize the tight reservoirs of the Northern Great Plains. This area is important because it may contain as much as 100 Tcf of natural gas at shallow depths (less than 1,200 m). This type of natural gas, which was generated by anaerobic bacteria at shallow depths in accumulating sediments, has been generally overlooked in the past. However, recent discoveries in Canada and the USSR have shown the significance of these biogenic gas accumulations. In addition, this gas is entrapped in thin, discontinuous siltstones and sandstones deposited in an offshore shelf environment, a type of deposit that has been relatively unstudied in the geologic record.

423

PROJECT TITLE: Coal Creek State Forest -- Proposed Oil and Gas Leases
(Environmental Impact Statement)

INVESTIGATORS/ORGANIZATIONS: Brace Hayden, Montana Dept. of State Lands,
Helena, MT 59601, (406) 449-2074; Gary Knudsen, Montana Dept. of Natural
Resources and Conservation, Helena, MT 59601, (406) 449-3780

FUNDING AGENCY: State of Montana FUNDING AMOUNT: Approx. \$30,000

DURATION: 8/75 - 2/76 (Completed) LOCATION: MT - Flathead County

DESCRIPTION: The impacts of leasing 7,759 acres of state land for oil and gas exploration and development in the Coal Creek State Forest were studied. Proposed disturbances on such land would initially be seismic exploration utilizing "thumper trucks" and geo phones. Subsequent disturbances could include road construction, drilling of exploration wells, and development of oil and gas discoveries into commercial production (pipelines, pumping stations, etc.). The existing movement of the areas is discussed including: history, climate, hydrology, water quality, geology, topography, soils, vegetation, wildlife, and socio-economics. Also included in the description of the existing environment are other on-going environmental studies in the area and management consideration on the state forest. Three possible alternatives available to the State Board of Land Commissioners are discussed including: approval of the sale of leases with special conditions, disapproval of the sale and deferment of the sale. Environmental impacts for each of the alternative actions are discussed.

PUBLICATIONS: Final Environmental Impact Statement was issued on 2/15/76.

424

PROJECT TITLE: Economic Analysis of Oil Refining in Montana

INVESTIGATOR/ORGANIZATION: Paul E. Polzin, Bureau of Business and Economic Research, University of Montana, Missoula, MT 59801, (406) 243-5113

FUNDING AGENCY: U.S. Federal Energy Administration (through the Montana Energy Advisory Council)

FUNDING AMOUNT: \$2,886 DURATION: 5/76 - 7/76 (Completed)

LOCATION: MT - Statewide

DESCRIPTION: This two part study will provide (1) An overview of oil refining in Montana, including historic trends in output, employment, and sources of crude oil and characteristics of the oil refining industry; (2) Projected impact of alternative scenarios; (3) Projected declines in employment and earning for Montana and Billings area of alternative scenarios concerning future distribution of crude oil to Montana refineries. The scenarios will be developed by the Montana Energy Advisory Council. (NOTE: This study was part of the Northern Tier Crude Oil Study, Project No. 432.)

PUBLICATIONS: The Economic Importance of Montana Refineries and Projected Impacts of Curtailments in Canadian Petroleum Imports, Paul Polzin, July 1976. Available from the Montana Energy Office, Helena, MT 59601.

OTHER ENERGY SOURCES/Oil and Gas

425

PROJECT TITLE: Geochemistry and Petroleum Sources Rock Study of Carbonates

INVESTIGATOR/ORGANIZATION: J.G. Palacas, U.S. Geological Survey, Office of Energy Resources, Branch of Oil and Gas Resources, Box 25046, Denver Federal Center, Denver, CO 80225

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Geologic Division

DURATION: Late 1975 - 3/76 (Project may be resumed at a later date.)

LOCATION: MT (Western Williston Basin), FL, TX

DESCRIPTION: The major objectives are to determine the geochemical and geologic factors responsible for the preservation, generation, expulsion, migration, and accumulation of petroleum in carbonate rocks. Some of the factors which will be examined are type of rock, nature of original organic material, character and amount of kerogen and hydrocarbons, degree of thermal maturation, and development of porosity. Initial studies will be focused on carbonate sequences in the following areas: (1) Western Williston Basin, MT -- predominately lower and middle paleozoic rocks; (2) South Florida Basin, FL -- mesozoic rocks with emphasis on the lower cretaceous; (3) Permian Basin, west TX -- permian rocks.

426

PROJECT TITLE: Geology of Fractured Shales (9410-01766)

INVESTIGATOR/ORGANIZATION: William W. Mallory, U.S. Geological Survey, Geologic Division, Box 25046, Denver Federal Center, Denver, CO 80225, (303) 234-2993

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Geologic Div.

DURATION: Ongoing LOCATION: All conterminous west of Mississippi River

DESCRIPTION: Current work on Colorado and New Mexico now being published by Rocky Mountain Association of Geologists, Denver. Efforts similar to the approach used in the Colorado-New Mexico region will be adapted to the Utah-Wyoming-Montana region. This part is now underway.

PUBLICATIONS: W.W. Mallory. Oil and Gas from Fractured Shale Reservoirs in Colorado and Northwest New Mexico. 1977. Special publication No. 1, Rocky Mountain Association of Geologists, Denver, CO.

427

PROJECT TITLE: Holter Lake, Montana (9530-00574)

INVESTIGATOR/ORGANIZATION: G.D. Robinson, Western Environmental Geology Branch, U.S. Geological Survey, 345 Middlefield Road, Palo Alto, CA 94025, (415) 323-8111

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Geologic Division

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DURATION: 7/74 - 6/75 (Field work completed)

LOCATION: MT - Lewis and Clark County (Holter Lake)

DESCRIPTION: Objective - To complete and report on detailed geologic mapping 2 7 1/2 minute quadrangles at the junction between the Montana disturbed belt and the central Montana uplift, for the broad purpose of providing background information on structure and stratigraphy of value in the search for new mineral and fuel deposits in this promising but poorly understood region.

PUBLICATIONS: G.D. Robinson, et. al. Geologic Map of the Upper Holter Lake Quadrangle, Lewis and Clark County, MT, 1969, U.S. Geological Survey GQ-840. Remaining quadrangle (Beartooth Mountain) completed in 1966 but withheld pending transmittal of adjoining quadrangle to East by another author.

428

PROJECT TITLE: Permian Petroleum Source Rock Studies, Northern Rocky Mountain Area

INVESTIGATORS/ORGANIZATION: Edwin K. Maughan, George E. Claypool, U.S. Geological Survey, Geologic Division, Box 25046, Denver Federal Center, Denver, CO 80225, (303) 234-3465

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Geologic Division

DURATION: 7/75 - 6/80

LOCATION: MT, WY, UT, NV, ID

DESCRIPTION: The Meade Peak and Retort Phosphatic Shale Members of the Phosphoria Formation have been sampled at many places in UT, NV, ID, WY, and MT. The samples have been analyzed for their organic carbon content, trace elements, and hydrocarbon characteristics, and have been evaluated as sources of petroleum. Organic rich rocks in the thermally mature areas have been sources of petroleum which yet may be found in adjacent reservoir rocks; but in most of southwest Montana the thermally immature strata are potential oil shales, although present mining and extraction costs mitigate against processing them for oil.

PUBLICATIONS: (1) Organic Carbon in Shale Rocks of the Permian Phosphoria Formation of Eastern Idaho and Adjacent States -- A Summary Report. In Wyoming Geological Association Guidebook, 27th Annual Field Conference, 1975, p. 107-115. (2) George E. Claypool, Alonza H. Love, and Edwin K. Maughan. Organic Geochemistry, Incipient Metamorphism, and Oil Generation in Black Shale Members of the Permian Phosphoria Formation, Western Interior United States. In American Association of Petroleum Geologists Bulletin, Vol. 62, No. 1.

429

PROJECT TITLE: Mineral Resources of the Choteau 2 Degree Quadrangle, Montana

INVESTIGATOR/ORGANIZATION: Melville R. Mudge, U.S. Geological Survey, Geologic Div., Box 25046, M.S.905, Denver Federal Center, Denver, CO 80225

OTHER ENERGY SOURCES/Oil and Gas

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FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Geologic Div.

FUNDING AMOUNT: \$180,000 (FY77 \$42,000)

DURATION: 6/75 - 9/78

LOCATION: MT - Lewis and Clark, Teton, Pondera, Flathead, Lake, Missoula, Powell, and Glacier Counties

DESCRIPTION: Plans for this year include completion of geologic studies in the southeastern part of the Choteau 2 degree quadrangle for the purpose of evaluating the large aeromagnetic anomaly in the area. Concurrent with these studies will be gravity, ground magnetic geochemical, and isotope investigations; evaluation of the paleontologic, stratigraphic and oil shale potential in the two tertiary basins in and near the southern part of the quadrangle. Plans also include completion of mineral resource investigations of the additions to the Bob Marshall Wilderness.

PUBLICATIONS: (1) Preliminary Bedrock Geologic Map of Part of the Northern Disturbed Belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, and Powell Counties, Montana. M.R. Mudge, et. al., USGS Open-File Report 77-25, December 1976; (2) Geologic Map and Section of the Bob Marshall Wilderness and Study Areas, Lewis and Clark, Teton, Pondera, Flathead, Lake, Missoula, and Powell Counties, Montana. M.R. Mudge, et. al. Open File Report 77-350. June 1977. Both reports are available at Montana Bureau of Mines and Geology, Butte, MT 59701.

430

PROJECT TITLE: Montana Fuel Allocation Program

INVESTIGATOR/ORGANIZATION: John Braunbeck, Montana Energy Office, State Capitol, Helena, MT 59601, (406) 449-3940

FUNDING AGENCY: State of Montana(current); U.S. Federal Energy Admin. (prior)

DURATION: 10/73 - Continuing

LOCATION: MT - Statewide

DESCRIPTION: Under the Emergency Petroleum Allocation Act of 1973 and Governor Judge's Executive Order No. 6-76, the Montana State Fuel Allocation Office was created and housed within the Montana Energy Office. The Montana State Fuel Allocation Office was created to effectively and efficiently administer the state fuel allocation program as provided within the Mandatory Petroleum Allocation and Price Regulation guidelines. The Montana State Fuel Allocation Office provides relief for petroleum hardship and emergency fuel problems. In addition, the Office provides technical assistance to the people of Montana in the form of information and procedures necessary to solve problems such as allocation adjustment, new business fuel requirements, impact area requirements, interruptible natural gas customer's standby fuel needs, and regulation advice.

PUBLICATIONS: Annual Reports are available from the Fuel Allocation Officer, Montana Energy Office, State Capitol, Helena, MT 59601.

431

PROJECT TITLE: Montana Natural Gas Supply Study

INVESTIGATOR/ORGANIZATION: Thomas W. Frizzell, Montana Environmental Quality Council, State Capitol, Helena, MT 59601, (406) 449-3742

FUNDING AGENCY: State of Montana (Environmental Quality Council)

DURATION: Completed 11/76

LOCATION: MT - Statewide

DESCRIPTION: A major objective of this study is to place Montana's natural gas crisis in perspective, to provide a framework within which various alternatives may be evaluated, and to stimulate reasoned and competent public discussion concerning what could be done to secure natural gas supplies sufficient to meet Montana's short-term and long-term needs. The study addresses many issues, including: Montana's reliance on Canadian gas imports; the extent to which the future of Montana's economy is dependent on the availability and cost of gas; the role energy conservation can play in reducing gas demand, and how it can be encouraged in Montana; whether industrial consumers are planning to shift to other fuels, and how much gas can be freed thereby for other uses; and whether synthetic gas can be produced and consumed economically in Montana.

PUBLICATIONS: Thomas W. Frizzell. Montana's Natural Gas Supply Crisis. An EQC Staff Report, November 1, 1976 (Out-of-print).

432

PROJECT TITLE: Northern Tier Crude Oil Study

INVESTIGATOR/ORGANIZATION: James H. Nybo, Mt. Energy Advisory Council, Capitol Station, Helena, MT 59601, (406) 449-3940

FUNDING AGENCIES: U.S. Federal Energy Administration; Mt. Energy Advisory Council

FUNDING AMOUNT: \$13,836 (FEA); \$1,180 (MEAC)

DURATION: 5/76 - 7/76 (Completed)

LOCATION: MT- Statewide

DESCRIPTION: This project involved the documentation of the historical and current refinery and pipeline situation in Montana, including both an examination of data and direct involvement with the refinery and pipeline industry. The study included the following components: (1) A refinery and pipeline survey; (2) A study of alternatives which show promise toward full or partial solution of the feedstock supply problem; (3) A study of synthetic liquids from coal; (4) A study of natural gas/condensate from Montana formations; (5) A study of the economic impacts of refinery shutdown and pipeline construction.

PUBLICATIONS: (1) Montana Petroleum Situation, MEAC Staff Paper 76-1, May 1976, revised September 1976; (2) Paul E. Polzin. Economic Importance of Montana's Refineries and Projected Impacts of Curtailments in Canadian Petroleum Imports. A Report to MEAC, July 1976; (3) Maher Ibrahim. Undiscovered Natural Gas Resources of Montana, A Report to MEAC, July 1976. (4) John R. McBride. Coal Liquefaction: Technology, Impacts, and Technical Suitability for Montana, a Report to MEAC, September 1976. All reports available from the Montana Energy Office.

OTHER ENERGY SOURCES/Oil and Gas

433

PROJECT TITLE: Oil and Gas Lease Applications Exploration and Development, Flathead National Forest -- USDA Forest Service Environmental Impact Statement

INVESTIGATOR/ORGANIZATION: E.L. Corpe, Flathead National Forest, 290 North Main Street, Kalispell, MT 59901

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service

DURATION: 3/75 - 4/76 (Completed) LOCATION: MT - Flathead Nat'l. Forest

DESCRIPTION: Oil and gas lease applications have been received on 236,000 acres of National Forest lands in Flathead County, Montana. The action in this statement consists of Forest Service recommendations to the U.S. Department of Interior, Bureau of Land Management, State Office, Billings, MT. The recommendations are as follows: (1) The denial of leases on approximately 53,000 acres; (2) The granting of leases with special stipulations on approximately 59,000 acres; (3) The granting of leases with a no-surface occupancy stipulation of approximately 32,000 acres; and (4) The deferment of leases on approximately 92,000 acres. The BLM is the agency responsible for the management of the vegetation and other surface resources on the National Forest Lands.

PUBLICATIONS: Oil and Gas Lease Applications Exploration and Development, R-1 75-11, Flathead National Forest. USDA Forest Service Draft EIS, June 19, 1975; Final EIS, April 30, 1976.

434

PROJECT TITLE: Petrology of Sandstones, Bridger Range, Montana

INVESTIGATOR/ORGANIZATION: Robert A. Chadwick, Dept. of Earth Sciences, Montana State University, Bozeman, MT 59715, (406) 994-3331

FUNDING AGENCY: Montana Power Company, Butte, MT FUNDING AMOUNT: \$10,863

DURATION: 9/74 - 8/75 (Completed)

LOCATION: MT - Bridger Range and adjacent areas on western margin of Crazy Mountains Basin

DESCRIPTION: A study was conducted of the Frontier Formation of Cretaceous age in the Bridger Range and adjacent areas on the western margin of the Crazy Mountains Basin. The study included field mapping and measuring of stratigraphic sections of the formation where exposed and petrographic study of rock samples. A concept of the environment of deposition of the formation was formulated. The objective was to improve knowledge of the formation and its extent into the Crazy Mountains Basin to allow a more intelligent evaluation of its potential as a natural gas source.

PUBLICATIONS: Petrography, Stratigraphy, and Environment of Deposition of the Frontier Formation in the Western Part of the Crazy Mountains Basin, South Central Montana. M.S. Thesis, J.J. Tonnsen, 1975.

435

PROJECT TITLE: Pilot Demonstration -- Enhanced Oil Recovery by Micellar-Polymer Waterflooding, Bell Creek Field, Montana

INVESTIGATORS/ORGANIZATION: Arnold Goldburg, Fred A. Haddenhorst, Gary Operating Company, 4 Inverness Court E., Englewood, CO 80110, (303) 770-4710

FUNDING AGENCIES: U.S. Energy Research and Development Administration; Gary Operating Company

FUNDING AMOUNT: \$2,500,000 (ERDA); \$2,500,000 (Gary Operating Co.)

DURATION: 7/75 - 6/81

LOCATION: MT - Powder River Basin, Bell Creek Field, Powder River and Carter Counties

DESCRIPTION: Gary Operating Company is conducting an ERDA Pilot Demonstration to determine whether micellar-polymer waterflooding is an economically feasible technique for enhanced oil recovery at the Bell Creek Field, Powder River Co., in southeastern MT. The pilot is a contained 40-acre 5-spot embedded in a representative watered-out part of the field. The pay is sandstone with average properties as follows: thickness of 7 feet, porosity of 26%, permeability (air) 1000 md and water TDS of 1000-3000 ppm. The residual oil saturation after waterflood is presently evaluated at 38%; and the overall micellar-polymer recovery is estimated at 60%, or 440 STB/Acre Foot with total recovery in the contained 40-acre pilot calculated to be 91,100 barrels. This project will run comparative laboratory tests on two micellar-polymer systems, one primarily water external and one primarily oil external. After the effectiveness of each has been determined, a selection of the more promising design will be made for use in the pilot demonstration. If the pilot is successful, expansion of the process to the full Bell Creek Field could return an additional 54 million barrels after waterflood and will have application to similar Montana-Wyoming sandstone reservoirs.

PUBLICATIONS: A. Goldburg, C.E. Morgenthaler. Micellar-Polymer Oil Recovery Demonstration in the Bell Creek Field, Montana. Delivered at ERDA Symposium on Enhanced Oil and Gas Recovery, Tulsa, September 1976, Proceedings Paper A.5, Petroleum Publishing Co., Tulsa, 1976.

436

PROJECT TITLE: Study of Future Natural Gas Prices in Montana

INVESTIGATOR/ORGANIZATION: Richard L. Stroup, Dept. of Agricultural Economics and Economics, Montana Agricultural Experiment Station, Montana State Univ., Bozeman, MT 59715, (406) 994-3701

FUNDING AGENCY: State of Montana (Dept. of Administration, Office of Budget and Program Planning) -- through the Montana Energy Advisory Council

FUNDING AMOUNT: \$2,590

DURATION: 11/76 - 1/77 (Completed)

LOCATION: MT - Statewide

OTHER ENERGY SOURCES/Oil and Gas

436 CONT.

DESCRIPTION: The primary objective of this project was to project prices for natural gas in the State of Montana. A combination of traditional econometric analyses and consultation with knowledgeable representatives of government and private industry were used to develop "best estimates" for prices for 1980, 1985, and 1990. The results of this project are intended as an aid to decision-making in the Office of the State Architect.

PUBLICATIONS: Richard Stroup. Projecting Natural Gas Prices in Western Montana. Prepared for the Mt. Dept. of Admin. and MEAC, January 1977. Available from the Montana Energy Office, Capitol Station, Helena, MT 59601.

437

PROJECT TITLE: A Study of the Potential for Additional Natural Gas and Natural Gas Condensate Production from Montana Formations

INVESTIGATOR/ORGANIZATION: Maher A. Ibrahim, Petroleum Engineering Dept., Montana College of Mineral Sciences and Technology, Butte, MT 59701

FUNDING AGENCY: U.S. Federal Energy Administration (through the Montana Energy Advisory Council)

FUNDING AMOUNT: \$3,000

DURATION: 5/76 - 7/76 (Completed)

LOCATION: MT - Statewide

DESCRIPTION: The main purpose of this study is to independently examine existing information on natural gas production, exploration, reserves and expected new discoveries. Results will help to determine the possibilities of complete or partial replacement of the curtailed Canadian refinery feedstocks by Montana produced fossil hydrocarbons. The objectives can be summarized as an effort to find answers to some or all of the following questions: (1) What are the possibilities of new gas-condensate fields discoveries? (2) What are the possibilities of the increase of Montana crude oil production through either new oil discoveries or use of advanced recovery methods applied on present producing fields? (3) To what degree might the expected discoveries keep pace with the announced Canadian phaseout of exports of refinery feedstocks to Montana? (4) What are sufficient industrial conditions to achieve the goal of complete replacement of Canadian exports through Montana produced fossil hydrocarbons?

PUBLICATIONS: Maher A. Ibrahim. Undiscovered Natural Gas Resources of Montana, A Report to MEAC, July 1976. Available from the Montana Energy Office, State Capitol, Helena, MT 59601.

438

PROJECT TITLE: Western Interior Cretaceous Studies (9410-01084)

INVESTIGATOR/ORGANIZATION: C.W. Spencer, U.S. Geological Survey, Geologic Div., Box 25046, Denver Federal Center, Denver, CO 80225

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Geologic Div.

438 CONT.

DURATION: 7/74 - 10/77 (Completed)

LOCATION: MT, ND, SD, WY, UT, NM, NE, K , CO

DESCRIPTION: The project emphasizes regional stratigraphy of cretaceous sandstones and shales within and surrounding structural basins of the Western Interior Seaway. The oil and gas potential of these basins is being evaluated through the construction of detailed surface and subsurface cross sections and isopachous, facies, and paleogeographic maps. Selected typical stratigraphic traps will be modeled by detailed log examinations and seismic methods. These data will aid industry by accelerating discovery rates and making more efficient use of available drilling rigs. This project includes basic research on organic richness and thermal maturation of hydrocarbon source beds. These data will help predict time of hydrocarbon generation and subsequent migration and will provide additional control for predicting undiscovered recoverable oil and gas resources.

OTHER ENERGY SOURCES

2.2 HYDRO (LARGE-SCALE)

OTHER ENERGY SOURCES/Hydro

439

PROJECT TITLE: An Ex Post Facto Analysis of Army Corps of Engineers and Bureau of Reclamation Projects in Montana Concerning the Execution of Pre-Project Commitments to Minimize Adverse Environmental Impacts and Assess Energy Benefits

INVESTIGATORS/ORGANIZATION: R.L. Konizeski, V.A. Ciliberti, School of Forestry, University of Montana, Missoula, MT 59801, (406) 243-6614

FUNDING AGENCY: U.S. Department of the Interior, Office of Water Research and Technology; Univ. of Montana, School of Forestry

FUNDING AMOUNT: \$7,075 (OWRT); \$2,472 (UM - indirect costs)

DURATION: 10/77 - 9/78

LOCATION: MT - Lake Koocanusa (Libby Dam) and Hungry Horse Reservoir

DESCRIPTION: Objectives - To assess the degree to which ex ante commitments have been realized and the projects effects upon stream channels and flood plain morphology. Projected vs. realized energy production will also be assessed. Approach - (1) An evaluation of pre-project commitments and execution concerning compensation and mitigation of primary and secondary losses to state and private holdings; (2) Review construction practices regarding stream channelization, borrow pits, vegetation and reclamation; (3) Examine operating techniques and their effects as exemplified by fluctuations in stream and pool levels; (4) Assess physical changes in stream and flood plain morphology; (5) Review status of electric energy production over time.

PUBLICATIONS: (1) Ph.D. dissertation; (2) Research Station Report

440

PROJECT TITLE: Flathead-Clark Fork River Basin -- Interim Hydropower Study

INVESTIGATORS/ORGANIZATION: Colonel John Poteat, John D. Welch, U.S. Army Corps of Engineers, Seattle District, P.O. Box C-3755, Seattle, WA 98124, (206) 764-3690

FUNDING AGENCY: U.S. Army, Corps of Engineers FUNDING AMOUNT: \$970,000

LOCATION: MT - Flathead and Clark Fork River Basins DURATION: 7/76 - 9/79

DESCRIPTION: The U.S. Army Corps of Engineers, in response to Congressional authority is investigating the water resources in the Flathead-Clark Fork River Basin. Emphasis will be on hydropower production, with evaluation of the local social, economic, and environmental effects a primary objective of the study. Initially, the study will involve a comparative analysis of hydropower sites in the basin. These comparative studies, involving preliminary economic, engineering, and environmental evaluations, will lead to selecting a plan for a more detailed evaluation, along with an impact analysis of the plan.

PUBLICATIONS: (1) Flathead-Clark Fork River Basin Hydropower Study, Public Brochure, Draft I, March 1977. Steven Foster, Seattle District, Corps of Engineers; (2) A report on the study and its findings and an environmental impact statement will be prepared.

OTHER ENERGY SOURCES/Hydro

441

PROJECT TITLE: Kootenai River Hydroelectric Project

INVESTIGATORS/ORGANIZATION: William Nordeen, Erval Rainey, Northern Lights, Inc., Box 310, Sandpoint, ID 83864, (208) 263-5141

FUNDING AGENCY: Northern Lights, Sandpoint, ID

DURATION: 12/75 - 12/78

LOCATION: MT - Troy, Kootenai River

DESCRIPTION: Northern Lights, Inc., a tri-state rural electric user-owned cooperative has received a preliminary permit from the Federal Power Commission to study a proposed hydroelectric project on the Kootenai River near the Idaho-Montana border and four miles upstream from Troy, Montana. This three-year feasibility study will look at impacts on natural resources and values, fish and wildlife resources, and engineering feasibility. If constructed, the power plant would provide an estimated annual generation of 500 million kilowatt hours of electricity.

PUBLICATIONS: Quarterly reports to the Federal Power Commission.

442

PROJECT TITLE: Missouri River: North Dakota, South Dakota, Nebraska, and Montana

INVESTIGATOR/ORGANIZATION: Chris Garvey, U.S. Army Corps of Engineers, Missouri River Division, U.S. Post Office and Court House, Omaha, NE 68101, (402) 221-7267

FUNDING AGENCY: U.S. Department of the Army, Army Corps of Engineers, Missouri River Division

FUNDING AMOUNT: \$1,557,000 (FY77 \$81,000)

DURATION: 7/72 - uncertain

LOCATION: MT, ND, SD, NE (Missouri River between Sioux City, IA and its headwaters at Three Forks, MT)

DESCRIPTION: This study in the Upper Missouri River Basin deals with overall water resources problems and the opportunities for including hydroelectric power generation at existing facilities. The study has identified potential additions of 185 MW and 272 MW at the existing Fort Peck, MT and Garrison, ND Dam projects, respectively. In addition, a pumped-storage project adjacent to Lake Francis County, SD and located in Gregory County, SD has been found economically feasible for 1180 MW of capacity.

PUBLICATIONS: (1) Missouri River: South Dakota, Nebraska, North Dakota, Montana -- Draft Environmental Impact Statement, February 7, 1977, U.S. Army Corps of Engineers, Missouri River Division, Omaha, NE; (2) Revised Draft EIS was filed in August 1977.

443

PROJECT TITLE: Western Energy Expansion Study

INVESTIGATOR/ORGANIZATION: Robert Madsen, Joel Busch, U.S. Bureau of Reclamation, Upper Missouri Region, P.O. Box 2553, Billings, MT 59103, (406) 657-6514

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Reclamation

FUNDING AMOUNT: \$292,000 (funding for entire study covering 197 western states)

DURATION: 2/76-10/76 (Completed)

LOCATION: 17 contiguous western states which make up the area of Reclamation's activities. The portion of that area for which the Upper Missouri Region is responsible is Montana east of the Continental Divide, North and South Dakota, and northern portions of Wyoming.

DESCRIPTION: The primary objective of the study was to identify, from known potentials, those undeveloped or underdeveloped hydroelectric generation opportunities which merit further study in the immediate future. The following are the specific areas of the appraisal-level study: (1) Upgrading turbines and generators at existing Reclamation hydroelectric power plants; (2) Constructing conventional hydroelectric and pumped storage installations which would be additions to existing Reclamation facilities; (3) Constructing new conventional hydroelectric, pumped storage and bulb-turbine power plants; (4) Investigating the possible application of mineral, geothermal, solar and wind energies, and integration of those energy forms with hydroelectric power generation for use in and around major western load centers; (5) Prioritizing proposed additional study needs for hydroelectric power generating potentials; (6) Reviewing institutional considerations including the role of public, private, and Federal power interests, planning authorization, and marketing processes.

PUBLICATIONS: Report on the Western Energy Expansion Study, U.S. Department of the Interior, Bureau of Reclamation, February 1977.

OTHER ENERGY SOURCES

2.3 URANIUM

OTHER ENERGY SOURCES/Uranium

444

PROJECT TITLE: Hydrogeochemical and Stream Sediment Reconnaissance (HSSR) of the National Uranium Resource Evaluation (NURE) Program

INVESTIGATOR/ORGANIZATION: Robert R. Sharp, Jr., Group G-5, Geochemical Applications, MS 586, University of California, Los Alamos Scientific Laboratory, P.O. Box 1663, Los Alamos, NM 87545, (505) 667-7590

FUNDING AGENCY: U.S. Energy Research and Development Administration

FUNDING AMOUNT: \$10,000,000 (FY77 1.5M) -- About \$0.5M will be spent in commercial sampling and pilot study work in Montana.

DURATION: 4/75 - 10/80

LOCATION: MT, WY, NM, CO, AK -- In Montana, sampling has been completed in the following AMS 20 map sheets: Kalispell, Hamilton, Elk City, Dillon, Bozeman, Dubois, Ashton, Ekalaka, the eastern-most part of the Hardin sheet, and the southeast part of the Butte sheet in the vicinity of the Boulder Batholith.

DESCRIPTION: The purpose of the HSSR of the NURE program is to aid in the evaluation of the nation's uranium resources and identify areas of interest for uranium exploration. The LASL is carrying on reconnaissance sampling of surface waters, ground waters, stream and lake sediments throughout the states of MT, WY, AK, NM, and CO. The average sampling density in the State of Montana is one sample per ten square kilometers (four square miles). While management, planning, sample analysis, data handling, evaluation, and reporting are done by the LASL at Los Alamos, NM, sampling is done by professional contractors throughout the states involved. These contractors are selected by competitive bidding, and samples are collected according to strict written specifications provided by the LASL. In addition to the reconnaissance surveys, state universities are contracted to study the effects of different sampling procedures, seasonal variations, and sampling densities. The University of Montana is presently conducting two such pilot surveys in the western part of the state.

PUBLICATIONS: LASL Quarterly Progress Reports for the HSSR Program, as well as all reports of reconnaissance results, can be obtained through the ERDA Grand Junction Officer, Grand Junction, CO. Reports are now being prepared for those areas in which sampling has been completed. Results of the reconnaissance and pilot surveys will be released to the public as soon as possible. The reports will contain uranium concentration overlays covering areas generally conformable to the USGS 1:250,000 topographic map boundaries. The main purpose of the reports is to present data and the conditions under which it was gathered. The bulk of data evaluation is left to the private sector, but the data can be used as an aid in the evaluation of uranium resources and to delineate areas of greatest interest for uranium ore exploration.

445

PROJECT TITLE: In-Situ Uranium Mining, Long Pines, Montana

INVESTIGATOR/ORGANIZATION: Gary L. Dusek, R. Martinka, Montana Dept. of Fish and Game, Ecological Services Div., P.O. Box 1123, Baker, MT 59313, (406) 778-3648

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Office of Biological Services

OTHER ENERGY SOURCES/Uranium

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FUNDING AMOUNT: \$90,000 (FY77 \$32,000)

DURATION: 9/76 - 8/79

LOCATION: MT - Sioux Div., Custer National Forest, Carter County.

DESCRIPTION: Objectives - (1) To identify conflicts between in-situ mining techniques and wildlife populations and develop guidelines and alternative methods for eliminating or reducing those conflicts; (2) To conduct studies that will furnish ecological data needed to monitor the effects of solution mining techniques in vegetation and wildlife resources; (3) To utilize the Long Pines as a model demonstration site for researching the compatibility of wildlife, vegetation and solution mining; (4) To identify revegetation techniques that may be specific for solution mining or other in-situ procedures; (5) To monitor secondary impacts from in-situ mining activities on wildlife populations and develop alternatives to reduce the impacts.

446

PROJECT TITLE: Sioux Planning Unit, Custer National Forest -- Environmental Impact Statement

INVESTIGATOR/ORGANIZATION: D.C. MacIntyre, U.S. Department of Agriculture, Forest Service, Custer National Forest, P.O. Box 2556, Billings, MT

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service, Custer Nat'l. Forest

DURATION: Completed 11/76 LOCATION: MT - Custer Nat'l Forest, Sioux Unit

DESCRIPTION: The Sioux Planning Unit is of particular resource interest because of the uranium, oil and gas exploration that has taken place within the Unit since 1972. Mobil Oil Corporation staked 1,165 claims covering approximately 23,000 acres in the Long Pines several years ago. They began exploratory drilling on these claims in 1973 to prospect suspected uranium deposits in the Fox Hill sand formation. The outcome of this on-going exploration will not be known for several years. An oil well exists on the Planning Unit in the North Cave Hills. It has produced over one-quarter million barrels of oil since April 1972. It is the largest producing oil well in SD. It seems probable that there will be more discovery and development of oil or gas in the Planning Unit. Future development could result in small 1-5 well fields, although there may be a potential for discovery of larger fields.

PUBLICATIONS: Final EIS issued November 23, 1976.

447

PROJECT TITLE: Uranium Water and Sediment Geochemistry of Boulder Batholith, Western Montana

INVESTIGATORS/ORGANIZATION: Arnold Silverman, Ian Lange, Dept. of Geology, University of Montana, Missoula, MT 59801, (406) 243-5151

FUNDING AGENCY: U.S. Energy Research and Development Administration (through Los Alamos Scientific Laboratories)

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FUNDING AMOUNT: \$14,364

DURATION: 5/76 - 9/76 (Completed)

LOCATION: MT - Boulder Batholith between Helena and Butte

DESCRIPTION: Sampling of water and stream sediments for uranium in the area between Helena and Butte, MT (Boulder Batholith). Geology Department will collect samples and analysis will be conducted at Los Alamos Laboratories.

(NOTE: This study is part of "Hydrogeochemical and Stream Sediment Reconnaissance of the National Uranium Resource Evaluation," Project No. 444.)

RENEWABLE ENERGY SOURCES

3.1 BIOMASS

448

PROJECT TITLE: Biological, Biochemical and Chemical Engineering Techniques Applied to the Conversion of Waste Matter to Useful Products (RAE 86 & 401)

INVESTIGATOR/ORGANIZATION: John E. Robbins, Department of Chemistry, Montana State University, Bozeman, MT 59715, (406) 994-4123

FUNDING AGENCY: State of Montana (Energy Planning Div., Montana Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: FY77 \$19,480; FY78 \$32,637 DURATION: 12/76 - 12/78

LOCATION: MT

DESCRIPTION: This study will define the areas of fundamental research needed to efficiently convert waste material to fuel and other products. The waste materials that could be used for such purposes are garbage, municipal sewage, and agricultural waste. The agricultural industry of the state produces approximately 5 million tons of waste straw per annum from wheat and barley. The livestock waste produced by beef-feed lot operation and confined animal production are unestimated at present. These agricultural wastes are amenable to conversion to fuel. The benefits of converting waste to fuel and other products are two-fold: (1) The production of quality fuel; and (2) The decrease in waste that must be disposed of at a direct cost to the public or as an undetermined cost to environmental quality. There is also possibilities of products that could be derived in addition to the fuel. These may be fertilizer and livestock feed. This study has two basic objectives for increasing the efficiency of fuel production from waste material: (1) To increase the number of useful products obtainable from the process of waste treatment and to inspect the possibilities of increasing the metabolic efficiency of the microbial flora that are involved in the anaerobic conversion of "biomass" to useful products.

PUBLICATIONS: Quarterly and final reports are submitted to the Energy Planning Division, Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

449

PROJECT TITLE: A Comprehensive Survey of Biological Methane Production from Agricultural, Domestic, and Industrial Resources of Montana (RAE 402)

INVESTIGATOR/ORGANIZATION: David M. Ward, Department of Microbiology, Montana State University, Bozeman, MT 59715, (406) 994-2902

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$23,910 DURATION: 1/78 - 1/79 LOCATION: MT

DESCRIPTION: This project will study the conversion of four sources (cattle manure, wheat straw, domestic sewage, and industrial hot water waste) of energy-rich organic matter available in large quantity in Montana to methane. The study will focus on establishing whether methane production reactions limit the rate of methane production and also the efficiency of conversion of wastes to

RENEWABLE ENERGY SOURCES/Biomass

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methane. The study is expected to result in (1) establishment of basal rates of methane production for all four wastes, and (2) the potential to increase efficiency of conversion to methane by a factor of three or greater, (3) the potential to accelerate the rate of waste conversion to methane, (4) greater stability in the digestion of all four wastes, and (5) the framework for rapid production of methane from sunlight via production and decomposition of algal mats in thermal wastewater effluents. Until methane production from these resources of Montana is studied in prototype digestors this enormous pool of energy-rich materials cannot be efficiently converted to a useful fuel and remain a problem of disposal to the environment.

PUBLICATIONS: Quarterly and final reports are submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

450

PROJECT TITLE: Ethanol Feasibility Study

INVESTIGATOR/ORGANIZATION: To be determined.

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING: \$25,000

DURATION: To be determined

LOCATION: MT

DESCRIPTION: The Alternate Energy Advisory Council has recommended that funds be set aside for use in resolving unanswered questions concerning the feasibility of ethanol fermentation. This will concern areas such as: higher-yielding, high carbohydrate species of grain or other types of plants, farm site fermentation of grain, new, high-efficiency fungi that ferments plant matter to produce ethanol and other areas, yet to be determined.

PUBLICATIONS: Quarterly and final reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

451

PROJECT TITLE: Feasibility of the Conversion of Wheat and Barley Into Alcohol

INVESTIGATOR/ORGANIZATION: Douglas G. Smith, Montana Dept. of Community Affairs, Capitol Station, Helena, MT 59601, (406) 449-2402

FUNDING AGENCY: State of Montana (Mt. Dept. of Community Affairs)

FUNDING AMOUNT: \$4,500

DURATION: 4/77 - 7/77 (Completed)

LOCATION: MT - Statewide

DESCRIPTION: The purpose of this study is to determine the feasibility of the conversion of wheat and barley into alcohol, creating both a new use for Montana wheat and barley and a viable alternative energy source. Since there has already been a great deal of study on the conversion of grain into alcohol in other states,

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this project will concentrate on the economic feasibility of such a process and explore alternative methods of funding such action. It will also explore the desirability of a producer check-off tax as a method of funding any proposed conversion facility. In addition, there will be cooperative efforts with other states interested in the research and development of such facilities.

PUBLICATIONS:

452

PROJECT TITLE: Montana Solid Waste Management Program

INVESTIGATOR/ORGANIZATION: Duane Robertson, Solid Waste Management Bureau, Montana Dept. of Health and Environmental Sciences, Helena, MT 59601, (406) 449-2821

FUNDING AGENCY: State of Montana (authorized by Legislature, SB 175)

FUNDING AMOUNT: \$2,300,000 (\$300,000 planning grants; \$2,000,000 organizational loans)

DURATION: 7/77 - 6/79

LOCATION: MT - Statewide

DESCRIPTION: The 1977 Montana State Legislature enacted a bill which authorizes the Montana State Department of Health and Environmental Sciences to create a local government grant fund for the creation of a solid waste management program. The purpose of this Act is to encourage the good management of solid waste and the conservation of natural resources through the promotion or development of systems to collect, separate, reclaim, recycle, and dispose of solid waste for energy production purposes where economically feasible and to provide a coordinated state solid waste and resource recovery plan.

PUBLICATIONS: Draft 1977 Montana State Plan for Solid Waste and Hazardous Waste Management, and Resource Recovery. June 1977. Mt. Dept. of Health and Environmental Sciences, Solid Waste Management Bureau.

453

PROJECT TITLE: Montana Solid Waste Management and Resource Recovery Study

INVESTIGATOR/ORGANIZATION: Terrence D. Carmody, Solid Waste Management Bureau, Mt. Dept. of Health and Environmental Sciences, Helena, MT 59601, (406) 449-2821.

FUNDING AGENCIES: State of Montana (authorized by Legislature); U.S. Environmental Protection Agency

FUNDING AMOUNT: \$200,000 (State); \$40,000 (EPA)

DURATION: 7/75 - 12/76 (Completed)

LOCATION: MT - Statewide

DESCRIPTION: The primary objective of this study was to determine the feasibility of utilizing the combustible fraction of solid waste as an energy source and to

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also determine the feasibility of recovering secondary materials found in the State's solid waste. Also included in the basic scope of work is the filing of solid waste management plans for each of the 12 planning districts in the State. These management plans will indicate which available solid waste disposal method or methods is most economically feasible and environmentally acceptable.

PUBLICATIONS: A number of publications relating to this study were prepared by the consulting firm, Henningson, Durham and Richardson. These are available from the Solid Waste Bureau.

454

PROJECT TITLE: Pyrolytic Conversion of Cellulosic Materials (AER75-15930)

INVESTIGATOR/ORGANIZATION: Fred Shafizadeh, Wood Chemistry Laboratory, Univ. of Montana, Missoula, MT 59801, (406) 243-6212

FUNDING AGENCY: U.S. National Science Foundation FUNDING AMOUNT: \$165,000

DURATION: 6/76 - 11/78 LOCATION: MT

DESCRIPTION: The world-wide shortage of food and chemicals and tight supply of fossil fuels and petrochemicals necessitate fresh effort for efficient utilization of renewable cellulosic materials. These efforts should involve not only reassessment and application of existing technology, but also modernizing old processes and developing new ones. Pyrolysis of cellulosic materials provides an inherently efficient process for conversion of cellulosic materials to a wide range of useful products, including solvents, sugar, nutrients, furfural, acetaldehyde, acetic acid, methanol, charcoal, and different types of liquid and gaseous fuel. Specifically, this project is concerned with: (1) Depolymerization of cellulosic materials to levoglucosan and sugars; (2) Catalytic breakdown of cellulosic materials to levoglucosenone and other volatile, reactive olefinic compounds; (3) Increasing the accessibility and susceptibility of cellulosic materials to biological hydrolysis.

PUBLICATIONS: (1) Fred Shafizadeh, Industrial Pyrolysis of Cellulosic Materials, Appl. Polym. Symp., 28, 153 (1975); (2) Chemical Conversion of Wood and Cellulosic Wastes, Proceedings of the Montana Academy of Sciences, 33, 65, 1973; (3) Fred Shafizadeh and P.S. Chin, New Sources of Food and Chemicals, Proceedings of the 30th Northwest Wood Products Clinic, May 5-7, 1975; (4) Pyrolytic Conversion of Biomass to Useful Chemicals, presented by F. Shafizadeh at the University of Washington, Seattle, WA, August 24, 1976.

455

PROJECT TITLE: Evaluation of Utilization Potential of Dead Timber, Based on Analyses of Chemical Characteristics (Supp. 68 to 12/11/204/1)

INVESTIGATOR/ORGANIZATION: Fred Shafizadeh, Wood Chemistry Lab., University of Montana, Missoula, MT 59801, (406) 243-6212

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FUNDING AGENCY: U.S. Dept. of Agriculture, Forest Service

FUNDING AMOUNT: FY77 - \$8,500; Prior \$9,500

DURATION: 10/75 - 9/77

LOCATION: MT

DESCRIPTION: The Northern forests produce combustible materials at the rate of about 10 billion calories per year, per acre, half of which is decomposed by natural processes. Accumulation of forest fuel and the accompanied fire hazards are heightened by the mortality of the trees due to various causes. Timber harvesting removes about 50% of the organic material in the tree leaving the rest including the dead and decomposing materials as slash, which is generally disposed of by burning, with some accompanied environmental problems. According to the Forest Service, the slash produced in this region, since 1961, is estimated at about 120 million tons, more than half of which still remains in the forests. Because of the climatic conditions, the dead trees are not readily decomposed. In the state of Montana alone, there is about 37.5 million tons of salvable dead wood, equivalent to about 15 years' harvest. Some of these materials could be converted to fuel, chemicals and even food. This project involves chemical analyses and description of the available dead wood in order to determine the suitability for various applications leading to an integrated management of the forests in the state of Montana.

PUBLICATIONS: Rocky Mountain Forest Fuel, F. Shafizadeh, at the first Rocky Mountain Fuel Symposium, Brigham Young University, Provo, UT, January 30, 1976.

RENEWABLE ENERGY SOURCES

3.2 GEOTHERMAL

RENEWABLE ENERGY SOURCES/Geothermal

456

PROJECT TITLE: Color Infrared Aerial Photography -- Geothermal Resource Areas in Montana and Wyoming

INVESTIGATORS/ORGANIZATION: John Lloyd and Jerald Stroebele, U.S. Dept. of the Interior, Fish and Wildlife Service, Billings Office, Federal Building, 316 N. 26th Street, Billings, MT 59101

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service

FUNDING AMOUNT: \$25,700

DURATION: 7/75 - 9/76 (Completed)

LOCATION: MT - Madison, Park, Jefferson, Lewis and Clark, and Broadwater Counties; WY - Teton and Lincoln Counties

DESCRIPTION: The Fish and Wildlife Service obtained 1:24,000 scale color infrared photography of 1,600 square miles on 7 areas in Montana and two areas in Wyoming which may be impacted by development of geothermal resources. Ground truthing was completed during the summer of 1975 for later interpretation of the imagery according to habitat types.

PUBLICATIONS: The color infrared photography is stored in the Billings Office, Fish and Wildlife Service, and is used for project analyses on a case-by-case basis.

457

PROJECT TITLE: A Conceptual Design for Utilizing Geothermal Energy at Warm Springs State Hospital (RAE 504)

INVESTIGATOR/ORGANIZATION: Karen Barclay, Montana Energy and MHD Research and Development Institute, P.O. Box 3809, Butte, MT 59701, (406) 494-4569

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$9,000

DURATION: 7/77 - 7/78

LOCATION: MT - Deer Lodge County (Warm Springs)

DESCRIPTION: This is a conceptual design study which will gather data on the energy demand of Warm Springs State Hospital and explore the feasibility of utilizing the hot springs in the area to satisfy the demand. As a secondary objective, the Institute will seek additional funding for the demonstration of geothermal space heating at Warm Springs based upon projected results of the resource exploration. It is anticipated that the report prepared under this contract will enable the State to implement a broad-based energy conservation program at Warm Springs State Hospital.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

RENEWABLE ENERGY SOURCES/Geothermal

458

PROJECT TITLE: Feasibility and Pre-engineering Planning of Geothermal Heating System for the New Nursing Home and Present Hospital Facility in White Sulfur Springs, Montana (RAE 501)

INVESTIGATOR/ORGANIZATION: C/O John Bartos, Administrator, Mountainview Memorial Hospital, Box Q, White Sulphur Springs, MT 59645

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$2,000 DURATION: One year grant starting in early 1978

LOCATION: MT - Meagher County (White Sulphur Springs)

DESCRIPTION: The thrust of this project will be to drill a test well 121 feet deep and analyze the mineral content of the water temperature and flow rate. This project is a feasibility study for eventually heating the Mountainview Memorial Hospital with geothermally-heated hot water. The funding is for the test well only.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Division, Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

459

PROJECT TITLE: A Geothermally Heated Bank in White Sulfur Springs, Montana (RAE 503)

INVESTIGATOR/ORGANIZATION: Michael Grove, President, First National Bank, White Sulphur Springs, MT 59645, (406) 547-3331

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$28,500 DURATION: 7/77-7/78

LOCATION: MT - Meagher County (White Sulphur Springs)

DESCRIPTION: This project will utilize a geothermal heat source to provide heat for a new bank building being built in White Sulphur Springs, MT. The system would utilize heat exchangers to transfer heat from the geothermal water to the air heating system of the building. The geothermal heating system will consist of a 400 foot deep well, pump(s), connecting piping, a finned tube coil and a re-injection dry well of approximately 100 feet deep. Accomplishment of this project will help provide local experience expertise for those involved and provide information for Montana's geological and geothermal data base.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

460

PROJECT TITLE: Geothermal Reconnaissance of South

INVESTIGATOR/ORGANIZATION: Robert A. Chadwick, Dept. of Earth Sciences, Montana State University, Bozeman, MT 59715, (406) 994-3331

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Water Resources Division

FUNDING AMOUNT: FY77 \$35,524

DURATION: 6/75 - 6/78

LOCATION: MT - Southwest portion

DESCRIPTION: Objective - Conduct geological studies to evaluate the geothermal potential of southwestern Montana and to develop models for thermal water circulation in cooperation with the USGS Water Resources Division, Helena Office. Methods - Geologic mapping, structural analysis, soil temperature surveys, resistivity surveys, signal enhancement seismic surveys, fracture permeability studies.

PUBLICATIONS: Numerous. Contact investigator for a list of publications related to this study.

461

PROJECT TITLE: Geothermal Regime of the Pacific Northwest by Heat Flow and Microseismic Techniques (AER76-00108)

INVESTIGATOR/ORGANIZATION: D.D. Blackwell, Southern Methodist University, Dept. of Geological Sciences, Hillcrest and University, Dallas, TX 75222

FUNDING AGENCY: U.S. National Science Foundation

FUNDING AMOUNT: \$186,300

DURATION: 6/76 - 11/77

LOCATION: MT, WA, OR, ID (In MT - Helena-Marysville-Broadwater Region)

DESCRIPTION: The overall objective of the research is to develop an up-to-date understanding of the regional geothermal regime of the Pacific Northwest states. This will be accomplished by a focus on three specific objectives: (1) Reduce and interpret available heat flow data in the four-state region which has not been previously published; (2) Obtain and interpret new heat flow and microseismic data in central Idaho (the Idaho Batholith) and West Montana near Helena; and (3) Support the interpretive effort with new continuation models for heat flow data. The last compilation of heat flow data for the northwestern U.S. was six years ago. The available data today are more abundant by better than an order of magnitude. A new map will be prepared by the end of 1976. Field studies are planned for central Idaho because of thermal springs and scientific research in the region source and distribution of the evident heat. Studies in the Helena-Marysville-Broadwater Region of Montana will expand on deep drilling results in the area to determine whether surface thermal anomalies are produced: (1) By deep circulating ground water perturbing an otherwise normal regional background; or (2) By anomalously hot formations in the area. New analytical, as well as heat flow measurement techniques will be applied in these studies.

RENEWABLE ENERGY SOURCES/Geothermal

462

PROJECT TITLE: An Investigation of the Feasibility of Utilizing Geothermal Energy in a Residential Subdivision (RAE 59)

INVESTIGATOR/ORGANIZATION: William M. Spilker, Box 244, Helena, MT 59601

FUNDING AGENCY: State of Montana (Energy Planning Division, Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$15,000

DURATION: 3/77 - 3/78

LOCATION: MT - Lewis and Clark County (Helena)

DESCRIPTION: This project will investigate the feasibility of utilizing geothermal energy in a residential subdivision to provide space heat, along with other possible energy requirements. The grant funds will be to establish a demonstration model to test the practicability of the geothermal resource in a residence. The source of water is the naturally occurring Broadwater Hot Springs.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

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PROJECT TITLE: Microcrack Technology for Geothermal Exploration and Assessment (AER75-09588)

INVESTIGATORS/ORGANIZATION: Gene Simmons, Michael L. Batzle, Dept. of Earth and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, MA 02139, (617) 253-6393

FUNDING AGENCY: U.S. National Science Foundation, Geothermal Program, RANN

FUNDING AMOUNT: \$146,100

DURATION: 3/76 - 2/78

LOCATION: MT - Lewis and Clark County (Marysville geothermal area), Other areas being examined are Dunes Anomaly, CA, Raft River, ID, Black Rock Desert, NV

DESCRIPTION: The purpose of this investigation is to help determine the exact role fractures play in geothermal systems. Several geothermal areas are being studied and all show repeated episodes of fracturing and fracture sealing. These systems are dependent on the fluid conduction paths provided by open cracks. Core samples are being examined with several techniques including the scanning electron microscope, petrographic microscope, electron microprobe, differential strain analysis, and permeability and resistivity measurements. Information from microfracture morphology, porosity, and alteration and vein materials may prove to be useful guides in exploring for and evaluating geothermal areas and relating surface anomalies to physical properties at depth. The Marysville geothermal area is useful in this study because of the area's characteristics and the amount of information available. Unlike most geothermal areas, Marysville occurs in a metamorphic and intrusive igneous terrain. The Marysville system shows a strong dependence on fractures. Numerous regional and local geophysical and geologic data and well logs have been collected. Finally, a large amount of representative core samples are available.

463 CONT.

PUBLICATIONS: (1) M.L. Batzle and G. Simmons. Microfractures in Rocks from Two Geothermal Areas, in Earth Planet. Sci. Lett. 30, 71-93, 1976; (2) M.L. Batzle and G. Simmons. Fracturing and Sealing in Geothermal Systems. Proceedings Volume, NSF-RANN Geothermal Conference, Golden, CO, 1976, submitted; (3) M.L. Batzle, and G. Simmons. Geothermal Systems: Rocks, Fluids, Fractures. In The Earth's Crust: Its Nature and Physical Properties, Geophys. Monogr. Ser., Vol. 20, edited by J.G. Heacock, AGU, Washington, D.C. 1977.

464

PROJECT TITLE: Northwest Regional Planning Support for the Development of Geothermal Energy

INVESTIGATOR/ORGANIZATION: Don J. Karr, Geo-Heat Utilization Center, Oregon Institute of Technology, Oretech Branch, Klamath Falls, OR 97601, (503) 882-6321; Field team members will be selected from each of the six states in the study. Edward Wahl is the Regional Coordinator.

FUNDING AGENCIES: U.S. Energy Research and Development Administration; Cost sharing by states.

FUNDING AMOUNT: \$383,385 (ERDA)

DURATION: 9/77 - 9/78

LOCATION: MT, AK, ID, OR, WA, WY

DESCRIPTION: The Geo-Heat Utilization Center of Oregon Institute of Technology will conduct a regional operations research and system analysis for commercial development of geothermal resources in the states of AK, ID, MT, OR, WA, and WY. Realistic time-sequence scenarios will be developed for KGRAs and PGRAs of record using existing data, institutional factors and economic conditions. Initial scenarios will be analyzed and updated after critical review by presentations to governmental agencies, industry, community leaders and special-interest groups. Market and cost/benefit analyses and resource potential calculations will be performed for all scenario sites demonstrating commercial potential. Comparable projections will be made to the year 2020 between potential geothermal resource development and other energy sources. These tasks will be performed by project team members who are residents of respective states and the scenarios will reflect the states' desires for the development of their resources.

PUBLICATIONS: Periodic progress reports will be submitted to ERDA. A report presenting and describing the preliminary regional geothermal energy development scenario, and a complete final report describing the activities of the project will be submitted to ERDA at conclusion of project.

465

PROJECT TITLE: Phaze Zero Study Results -- Geothermal Potential of the Madison Group at Shallow Depth in Eastern Montana

INVESTIGATOR/ORGANIZATION: John L. Sonderegger, Montana Bureau of Mines and Geology, c/o Montana College of Mineral Science and Technology, Butte, MT 59701 (406) 792-8321

RENEWABLE ENERGY SOURCES/Geothermal

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FUNDING AGENCY: U.S. Energy Research and Development Administration, Geothermal Branch; Bureau of Mines and Geology

FUNDING AMOUNT: \$2,899 (ERDA); \$1,638 (Bureau of Mines & Geology)

DURATION: 7/1/77 - 11/77 (Completed)

LOCATION: MT - Statewide with emphasis on the Little Rockies.

DESCRIPTION: The study of shallow geothermal potential in the Madison Group limestone aquifer was started to provide information about large-volume, low temperature reservoirs that could have potential for space heating or for extended-crop-season irrigation. The report summarizes data available from federal and state sources. To date, eighty-one hot or warm springs are known in Montana. Twenty-nine of these springs are believed to originate in limestone of the Madison Group.

PUBLICATIONS: J.L. Sonderegger, R.N. Bergantino, and M.R. Miller. Report RLO-2426-T2-2 to ERDA. November 15, 1977. Open-File copy with Hydrology Division, Montana Bureau of Mines and Geology.

466

PROJECT TITLE: A Reconnaissance Study of Geothermal Potential in the Upper Parts of Red Rock Creek and Madison River Valleys, Southwestern Montana

INVESTIGATOR/ORGANIZATION: John L. Sonderegger, Montana Bureau of Mines and Geology, c/o Montana College of Mineral Science and Technology, Butte, MT 59701, (406) 792-8321.

FUNDING AGENCY: U.S. Energy Research and Development Administration, Geothermal Branch; Bureau of Mines and Geology

FUNDING AMOUNT: \$96,400 (ERDA); \$16,800 (Bureau of Mines and Geology)

DURATION: 7/77 - 9/79

LOCATION: MT - Beaverhead and Madison. Upper Centennial Valley (Red Rock Lakes Area) and southern portion of West Fork Madison drainage basin.

DESCRIPTION: The study of shallow geothermal potential in the Upper Red Rock Creek Drainage and the Lower Madison River Drainage is being conducted to evaluate the geothermal prospects of the area for any possible space-heating potential. This report includes some of the hydrologic field data obtained during the months of July through September 1977, when 47 streams and 46 springs were field inventories. Also there is a discussion of geologic mapping and an aerial thermal scan conducted during this same period.

PUBLICATIONS: J. Sonderegger, W. Bermel, D. Glasser. RLO-2426-T2-2 report to ERDA. November 15, 1977. Open-File copy with Hydrology Division, Montana Bureau of Mines and Geology. Preliminary report of results of summer's field work.

467

PROJECT TITLE: A Reconnaissance Study of Mine-Water Temperatures in Hardrock Mining Districts of Montana

INVESTIGATOR/ORGANIZATION: John L. Sonderegger, Montana Bureau of Mines and Geology, c/o Montana College of Mineral Science and Technology, Butte, MT 59701, (406) 792-8321

FUNDING AGENCY: U.S. Energy Research and Development Administration, Geothermal Branch; State (Bureau of Mines and Geology)

FUNDING AMOUNT: \$19,688 (ERDA); \$2,000 (State) DURATION: 5/76 - 5/78

LOCATION: MT - Statewide

DESCRIPTION: Objective - To measure mine water temperatures in up to three mines in each of the 250 hardrock mining districts. Data for regional geothermal data base.

PUBLICATIONS: J. Sonderegger, Don Lawson. Annual Report to ERDA, RLO-2426-T2-1. January 1977. Copy available for inspection at Hydrology Division, Montana Bureau of Mines and Geology.

468

PROJECT TITLE: Regional Geothermal Hydrology of Southwestern Montana

INVESTIGATOR/ORGANIZATION: Robert B. Leonard, U.S. Geological Survey, Water Resources Division, Federal Building, Helena, MT 59601, (406) 449-5263; Montana State University is conducting related surface geological and shallow geophysical studies under a USGS extramural grant program. Dr. R.A. Chadwick is the principal investigator at MSU.

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey

FUNDING AMOUNT: \$180,000 (FY77 \$55,000) DURATION: 7/75 - 9/78

LOCATION: MT - south of latitude 47°N and west of longitude 110°W

DESCRIPTION: Objectives are - (1) To describe the thermal waters of southwestern Montana in terms of temperature, discharge, chemical character, areal distribution, and depth of occurrence; (2) To determine the nature of local and regional hydrogeologic controls on the occurrence of thermal water; (3) To develop conceptual models of selected hydrothermal flow systems as a guide to appraisal and potential development of the resource.

PUBLICATIONS: (1) Natural Radioactivity of Geothermal Waters, Alhambra Hot Springs and Nearby Areas, Jefferson County, Montana. Robert B. Leonard and Victor J. Janzer. U.S. Geological Survey Open-File Report 77-624, August 1977.

RENEWABLE ENERGY SOURCES/Geothermal

469

PROJECT TITLE: Rock Deformation, Montana (9550-00409)

INVESTIGATOR/ORGANIZATION: E.C. Robertson, U.S. Geological Survey, Geologic Division, 12201 Sunrise Valley Drive, Herndon, VA 22092

FUNDING AGENCY: U.S. Department of the Interior, Geological Survey, Geologic Division

DURATION: 7/75 - 6/76

LOCATION: Western MT

DESCRIPTION: Experiments on the mechanical properties of selected rock samples are performed under pressures to 10KB and heating to 300 degrees C and on the elastic properties of certain rock and mineral samples under a vacuum and heating to 1000 degrees C. Field studies are made of the geothermal regime and overthrust faulting of western Montana. Experimental results and field observations are combined in assessing such problems as the mechanics of overthrust faulting, earthquake mechanisms, hydrothermal water circulation, geothermal energy, elastic properties and wave attenuation in rocks.

470

PROJECT TITLE: A Special Initiative Research Proposal for the Evaluation of a Geothermal Area of Abnormally High Heat Flow at Marysville, MT

INVESTIGATORS/ORGANIZATION: D.H. Stewart, W.R. McSpadden, Battelle Pacific Northwest Laboratories, Physics and Instrumentation Dept., Richland, WA 99352

FUNDING AGENCY: U.S. National Science Foundation, RANN

FUNDING AMOUNT: FY 73 - \$265,000; FY 74 - \$1,800,000; FY 75 - \$245,000

DURATION: 5/73 - 6/75

LOCATION: MT - Lewis and Clark County (Empire Mine, near Marysville), TX, WA

DESCRIPTION: The drilling of the deep geothermal research well at the Empire Mine, near Marysville, MT was completed on August 30, 1974. The hole was drilled to a depth of 6,790 feet through granite which was found to be highly fractured. Twelve major fracture zones were encountered, in addition to the extensive minor fractures throughout the region. The granitic body was intruded as hot magma probably about 40 million years ago and was fractured by cooling and other tectonic stresses. To the surprise of the scientists, large flows of water (255 GPM) from some fracture zones into others were measured in the well. Surface surveys conducted prior to 1974 of electrical resistivity, microseismics, heat flow, gravity, magnetic field, etc., failed to show the presence of the water. Expectations of finding a shallow magma chamber were based upon surface surveys and the hypothesis that the body was relatively free of water. However, no magma chamber was found and maximum temperatures encountered were about 200 degrees F. The source of this heat was not located. Although the project did not reveal a geothermal source of commercial value, the scientific information being generated will be of great value to the geothermal industry.

470 CONT.

PUBLICATIONS: The Marysville, Montana, Geothermal Project -- Preliminary Report; First Annual Report, Part 1 (Available from National Science Foundation.)

471

PROJECT TITLE: Water Quality Investigations in Geothermal Areas of Chico and Hunter Hot Springs, MT

INVESTIGATOR/ORGANIZATION: Robert B. Leonard, U.S. Geological Survey, Water Resources Division, Federal Building, Helena, MT 59601, (406) 449-5263

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Land Management, Energy Minerals Rehabilitation Inventory and Analysis (EMRIA) Program

FUNDING AMOUNT: \$12,000 DURATION: 10/76 - 9/77 (Completed)

LOCATION: MT - Park and Sweet Grass Counties

DESCRIPTION: This study is a reconnaissance baseline water quality study of tributaries to the Upper Yellowstone which may be affected by geothermal development.

PUBLICATIONS: (1) Interim Report, October 1977. Available from the USGS, Helena and Billings; (2) Robert B. Leonard, et. al. Water Quality Investigations Near the Chico and Hunters Geothermal Lease -- Application Areas, Park and Sweet Grass Counties, Montana. USGS Open-File Report (in final review).

RENEWABLE ENERGY SOURCES

3.3 HYDRO (SMALL-SCALE)

RENEWABLE ENERGY SOURCES/Hydro

472

PROJECT TITLE: Low Head, Low Impact Hydroelectric Energy Demonstration Project (RAE 603)

INVESTIGATOR/ORGANIZATION: Bill Delp, Independent Power Developers, Box 1467, Noxon, MT 59853, (406) 847-2211

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$25,000

DURATION: 7/77 - 7/78

LOCATION: Two locations in Montana to be selected by the Dept. of Natural Resources.

DESCRIPTION: The objective of this project is to install 2 low head hydro-electric systems capable of producing from 1,146 to 2,109 Kwh/mo. at locations to be chosen by the Montana Department of Natural Resources and Conservation. Preliminary research indicates that the newly developed fixed propeller type (Nagler) low head hydroturbines which IPD is proposing to demonstrate will more than double the potential number of localized power sites which were formerly restricted to heads of 50 feet or more. The system does not require the use of a dam, thus minimizing environmental impact as well as installation costs. The electrical application of these units could be utilized on farms, ranches, parks, remote industrial outposts (oil pumping, mining operations, etc.), vacation resorts and private residences.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

473

PROJECT TITLE: Low Impact Hydro-Electric Energy for Montanans (RAE 53)

INVESTIGATOR/OEGANIZATION: Bill Delp, Independent Power Developers, Box 1467, Noxon, MT 59853, (406) 847-2211

FUNDING AGENCY: State of Montana (Energy Planning Div., Montana Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$19,885

DURATION: 12/76 - 12/77

LOCATION: Three locations in Montana

DESCRIPTION: This project will demonstrate low impact, cost-effective hydro-electric systems. Six KW systems will be installed in northwestern, mideastern, and southwestern, Montana, thereby providing a general accessibility for western Montanans who have flowing water as their most abundant source of alternative energy. The expected result is to provide three complete 6KW hydro-electric systems, each capable of providing 17,112 kilowatt hours per year. This project is expected to demonstrate the environmental and economic significance of these mass-produced hydroelectric power plants.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Division, Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

RENEWABLE ENERGY SOURCES/Hydro

474

PROJECT TITLE: Potential Hydroelectric Power for State-Owned Dams

INVESTIGATOR/ORGANIZATION: Richard L. Bondy, Engineering Bureau, Water Resources Div., Montana Dept. of Natural Resources and Conservation, Helena, MT 59601, (406) 449-2864; Also, Tudor Engineering Co., San Francisco, CA, and R.C. Harlan Associates, San Francisco, CA.

FUNDING AGENCY: State of Montana (Montana Dept. of Natural Resources and Conservation)

FUNDING AMOUNT: \$20,000

DURATION: 6/77 - 12/77

LOCATION: MT - Ravalli, Broadwater, Golden Valley, Wheatland Counties

DESCRIPTION: The purpose of this project is to examine the potential engineering and economic feasibility of three small hydroelectric projects to be located at existing dams under the administration of Montana's Department of Natural Resources and Conservation. The projects were selected from statistical data on forty water conservation projects which had been compiled in a report prepared by the DNRC in March 1977. Sites located on three separate drainage systems were selected for review of their hydroelectric potential. A scheme of development for each site was prepared for the proposed power features along with modifications to the existing facilities where required. An assessment of the potential energy that could be generated at each site was computed based on hydrological records and physical characteristics of the site. A computer program, simulating the seasonal flow characteristics of the watershed and operation of the plants, was used to perform the energy studies. For the three projects combined, potential generation of 105 million kilowatt-hours would have an estimated market value in excess of \$2,700,000 annually. This generation is the equivalent of utilizing about 60,000 tons of coal in a modern coal-fired steam electric generating station. Potential markets for this power were identified in this study and means of delivery of the energy to the power purchaser. Small entities may be desirous of obtaining power from these installations with the declining availability of power from the government projects.

PUBLICATIONS: A report on potential hydroelectric power for state-owned dams by Tudor Engineering Co., and the Montana Dept. of Natural Resources and Conservation will be available at the conclusion of the project.

475

PROJECT TITLE: A Resource Survey of Low-Head Hydro-electric Potential -- Columbia River Basin/Idaho, Oregon, Washington, Montana

INVESTIGATORS/ORGANIZATIONS: Al Cunningham, Dept. of Civil Engineering and Engineering Mechanics, Montana State University, Bozeman, MT 59717, (406) 994-2111; John Gladwell, Idaho Water Resources Research Institute, Moscow, ID

FUNDING AGENCY: U.S. Energy Research and Development Administration

FUNDING AMOUNT: \$20,000

DURATION: 9/77 - 7/79

LOCATION: MT, OR, WA, ID (Columbia River Basin)

475 CONT.

DESCRIPTION: This study will review the potential for low-head hydro development in existing impoundments and evaluate the potential in currently undeveloped sites. The entire Columbia River drainage within the U.S. will be covered. The objectives of this project will be: (1) To review the records of existing private and public water impoundments that have a potential for low-head hydroelectric energy development and (a) determine why no energy development was originally installed, and (b) determine the potential for energy development; and (2) To survey the designated region for potential low-head energy developments, including the potential energy available at each site.

PUBLICATIONS. Quarterly and Final Report will be prepared.

476

PROJECT TITLE: A Small-Scale Hydroelectric Energy Supply System (RAE 603)

INVESTIGATOR: Terry Savage, P.O. Box 26, Lolo, MT 59847, (406) 273-6610

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Department of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$14,050

DURATION: One year grant starting in early 1978

LOCATION: MT - Superior

DESCRIPTION: This project will demonstrate a small-scale 12 kw hydroelectric energy supply system to be used to supply, on a continuous basis, 100 percent of the energy requirements for a modern 2,044 sq. ft. all-electric subterranean home located 7 miles southwest of Superior.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

RENEWABLE ENERGY SOURCES

3.4 SOLAR

RENEWABLE ENERGY SOURCES/Solar

477

PROJECT TITLE: Supplementary Solar Heating of Domestic Water Needs in Apartments, Institutions, and Other Large Users (RAE 06)

INVESTIGATOR/ORGANIZATION: Kenneth Nordtvedt, Jr., Physics Dept., Montana State University, Bozeman, MT 59715, (406) 994-3614

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$4,000

DURATION: 11/76 - 11/77

LOCATION: MT - Gallatin County (Bozeman)

DESCRIPTION: This project will construct, instrument, operate, and study the technology and economics of a solar energy pre-heater for the domestic hot water system of an 11-unit apartment building in Bozeman, Montana.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

478

PROJECT TITLE: Big Valley Solar House -- Residential Solar Heating and Cooling Demonstration (RAE 09)

INVESTIGATOR/ORGANIZATION: James E. Taylor, James E. Taylor & Associates, 2715 Airport Way, Helena, MT 59601, (406) 458-5232

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$12,750

DURATION: 11/76 - 11/77

LOCATION: MT - Lewis and Clark County (Helena)

DESCRIPTION: This is a project to install, test and evaluate the effectiveness and economic feasibility of a solar-assisted heat pump space heating system, solar-assisted domestic hot water heating system, and energy-efficient fireplace, and an energy efficient storage cooling system in a single family residence located in the North Helena Valley, Montana. The main objective of this project is to demonstrate and make known the feasibility of using solar energy in this type of system. Secondary to this goal is to add to the data source that will permit designers and contractors to incorporate solar and energy conserving systems into their work.

PUBLICATION: Quarterly and Final Reports will be submitted to the Energy Planning Division, Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

479

PROJECT TITLE: A Demonstration of the Feasibility of Total Household Energy Independence from Conventional Fossil-Fuel Sources (RAE 19)

INVESTIGATOR: Gail L. Owen, 7001 Bitterroot Road, Route 5, Missoula, MT, (406) 363-2549

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$11,362

DURATION: 11/76 - 11/77 (Completed)

LOCATION: MT - Missoula County

DESCRIPTION: The project will attempt to demonstrate the feasibility of supplying the majority of necessary household space and water heating from alternative energy sources, principally by means of: (1) extraordinary insulation; (2) a heat pump; (3) two solar flat plate collectors; and (4) integral design and control and operation. As a demonstration project this proposal is chiefly concerned with advancing the practical rather than the technological state of the art vis-a-vis solar power development for household use. It will do this by demonstrating that: (a) there are adequate means to meet home heating needs from renewable energy sources; (b) these means can readily be purchased or fabricated from available components; and (c) they can be installed and operated economically and with relative ease.

PUBLICATIONS: A Final Report on this project was submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

480

PROJECT TITLE: A Residence Heated by Solar Energy (RAE 32)

INVESTIGATOR/ORGANIZATION: Charles L. Herndon, Dept. of Engineering Science, Montana College of Mineral Sciences and Technology, Butte, MT 59701, (406) 792-8321

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$15,000

DURATION: 11/76 - 11/77

LOCATION: MT - Silver Bow County (Butte)

DESCRIPTION: The proposed system would achieve direct and indirect utilization of solar energy along with a conventional warm-air heating system. In addition to evaluating various components of a solar energy utilization system, various control arrangements and sequencing will be studied. One end result will be a computer program developed from data of various components tested and system operational data that would allow easy variation of the system parameters to optimize the size of the various solar components. The heating system planned will use a circulating warm air system, transferring heat from the thermal storage tank to the supply air by a finned coil in the air handling unit. A second finned coil in the air handling unit will draw energy from a fossil fueled water boiler when sufficient solar energy was not available.

480 CONT.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

481

PROJECT TITLE: Development and Demonstration of a New Concept in Solar-Powered Space Heating (RAE 33)

INVESTIGATOR: Sherman S. Cook, Jr., Lincoln, MT 59639, (406) 362-4413

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$10,500

DURATION: 11/76 - 11/77

LOCATION: MT - Lewis and Clark County (Lincoln)

DESCRIPTION: This project will continue development and demonstration of a new concept in solar-powered space heating adapted to both new construction and to some existing buildings. A portable self-contained demonstration unit will be made available to schools, associations of builders and architects and anyone else with an interest in promoting early and widespread use of solar heating. The unit will contain an 8-gallon insulated tank, collector panel, circulator pump and thermometer.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

482

PROJECT TITLE: Solar Insolation Measurement, Montana (RAE 46 & 084)

INVESTIGATOR: Charless Fowlkes, 1820 South 7th Ave., Bozeman, MT 59715, (406) 587-3779

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: 1977 - \$29,790; 1978 - \$35,490

DURATION: RAE 46 - 11/76 - 11/77 (Completed); RAE 084 - 1/78 - 1/79

LOCATION: MT - Stations in 30 locations

DESCRIPTION: This program will measure solar radiation at 30 different locations in Montana. The measurements are intended to broaden the solar insolation data base for Montana in order to implement and accelerate the utilization of solar energy. The measurements are oriented toward providing specific data for computing the energy gain of flat-plate collectors. The measuring stations will be located at selected Montana High Schools. Science teachers and students will assist in the operation of the measuring equipment. The cost of getting this essential data is consequently small. In addition to the data, important educational and promotional benefits will be provided by this program.

482 CONT.

PUBLICATIONS: A Final Report for RAE 46 has been submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

483

PROJECT TITLE: To Demonstrate the Feasibility of Utilization of Solar Energy in the Billings Micro-Climate (RAE 58)

INVESTIGATOR: James W. Coons, 208 N. 29th, Suite 21, Billings, MT

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$11,000

DURATION: 11/76 - 11/77

LOCATION: MT - Yellowstone County (Billings)

DESCRIPTION: The purpose of this project is to construct a solar energy collection and heating system for a new home. The system will include active space heating, domestic hot water, and space cooling solar features.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

484

PROJECT TITLE: Solar Collector, Tracing Mechanism, and Storage (RAE 64)

INVESTIGATORS/ORGANIZATION: Richard P. Sheridan and Dale E. Horton, Department of Botany, University of Montana, Missoula, MT 59801, (406) 243-2613

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$8,000

DURATION: 11/76 - 11/77

LOCATION: MT - Missoula County

DESCRIPTION: This effort will include research, development, and demonstration of a solar collector, heat storage and space heater system. Such a system will be designed so that construction of hardware may be accomplished in the home shop at an economical price. Further, the energy input for the original manufacturing of hardware components can be justified on the energy returned for space heating. Innovative contributions include a heat-sink modification to a flat-plate collector, the development of a glass-less collector, and a collector with a modified reflector. A multi unit heat storage system and a solar tracking sensor are also proposed. In addition to the finished working solar system, a major contribution which this project offers is a professional caliber layman's handbook which will be concerned not only with hardware and construction but also with applicability and availability of materials and costs in this region.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

485

PROJECT TITLE: Installation of Hot Air Solar Collector Systems in Low Income Homes (RAE 69)

INVESTIGATOR/ORGANIZATION: Ken Boggs, District 11, Human Resources Council, 207 East Main, Missoula, MT 59801, (406) 728-3710

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$26,875 DURATION: 1/77 - 1/78 (Extended to 6/78)

LOCATION: MT - Missoula County

DESCRIPTION: This project will construct and install a hot air solar collector system in a limited number of low-income homes. The contracting agency will develop a practical model of the collector system and will demonstrate the application in ten residences. The key component in this system is a solar collector from a NASA design (panels can be produced for less than a \$1.00 per sq. ft., and each sq. ft. can provide nearly 100,000 BTU's during a heating season in Montana. The Council intends to demonstrate that such a system can provide at least 40% of a home's heat requirement at a cost comparable with currently popular supplemental heating systems.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

486

PROJECT TITLE: To Demonstrate the Use of Solar Energy to Heat a New Home (RAE 79)

INVESTIGATOR: Mike Stoltz, 109 5th Highland Park, Glendive, MT

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$3,805 DURATION: 11/76 - 11/77 (Extended to 6/78)

LOCATION: MT - Dawson County (Glendive)

DESCRIPTION: The project proposes to build and demonstrate a solar heating system which has been employed in other areas of the U.S. This will be done by constructing a unit utilizing beer cans for the collector surface with wood framing and a vinyl or fiberglass covering. According to some data this type of collector has produced as much heat as the most expensive on the market. If the project is successful it is expected that a layman could build a solar collector that would provide 30% of his heat for a home for \$1500-1600. As better storage facilities are developed, this project could meet 30%-50% of the homeowners heating needs. This project is extremely compatible with the environment and uses a resource, beer cans, that are now a solid waste problem in Montana.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

RENEWABLE ENERGY SOURCES/Solar

487

PROJECT TITLE: Solar/Heat Pump in Home (RAE 84)

INVESTIGATOR: William B. Tomlinson, 403 Colorado Avenue, Great Falls, MT 59404, (406) 452-0442

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$7,166.50

DURATION: 11/76 - 11/77

LOCATION: MT - Cascade County (Great Falls)

DESCRIPTION: This will be a demonstration project for a low-cost, home-made solar heating system which will incorporate a heat pump. The major objectives will be to: (1) prove that a solar system can be built by many individuals that will do the required job for less than the \$10-\$20 per sq. ft. of the commercial patented collector system; (2) know how long a large volume of heat can be stored by such a storage tank. Figuring a temperature range of from 75° F to 160° F this tank and concrete and rock could retain approximately 5,500,000 BTU of heat. This system is intended to cut use of natural gas 75% this year and completely next year.

PUBLICATIONS: Quarterly and Final Reports are submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

488

PROJECT TITLE: Solar Collector in Conjunction with Heat Pump for Residential Heating (RAE 90)

INVESTIGATOR: David Leavengood, Bridger Canyon Rural Route 2, Bozeman, MT, (406) 586-5717

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$10,500

DURATION: 11/76 - 11/77

LOCATION: MT - Gallatin County (Bozeman)

DESCRIPTION: This project is dealing with solar energy as an active heating source to be used in conjunction with an electric heat pump using outdoor air as a heat source and heat sink with air as a distribution fluid. The project will use solar energy as a source for preheating air entering the condensor side of the heat pump. This preheating is done in order to maintain the heat pump's efficiency when exterior temperatures drop below 20° F, or at those times when the efficiency of the heat-pump falls.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

489

PROJECT TITLE: Feasibility and Pre-Engineering Planning of Solar Application for a New Junior-Senior High School in Belgrade, Montana (RAE 91 & 069)

INVESTIGATOR/ORGANIZATION: Board of Trustees, School District #44, Belgrade Public Schools, Belgrade, MT 59714, (406) 388-6862

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: 1977 - \$10,750; 1978 - \$1,500

DURATION: RAE 91 - 11/76 - 11/77 (Complete); RAE 069 - 1/78 - 1/79

LOCATION: MT - Gallatin County (Belgrade)

DESCRIPTION: This project is a feasibility and pre-engineering study for solar heat application to a new junior/senior high school in Belgrade, Montana to be constructed in 1977. This study in addition to providing the necessary data for a solar aided building will provide other Montana communities desiring to build a solar supplemented school with a process model. The grantee will prepare a handbook that will explain the steps other schools should follow when considering solar heating for a new building.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Montana Dept. of Natural Resources and Conservation, Helena, MT 59601.

490

PROJECT TITLE: Solar Energy Demonstration Project (RAE 92)

INVESTIGATOR: L. Clark MacDonald, Bootlegger Trail, Great Falls, MT, (406) 452-5967

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$3,743.70 DURATION: 11/76 - 11/77 (Extended to 7/78)

LOCATION: MT - Cascade County (Great Falls)

DESCRIPTION: The project will combine solar flat plate collectors, increased insulation, a heat pump and water heat storage system fitted to an existing farm home. The major objectives of this project are to: (1) keep cost factors to a minimum and yet produce a system that will be as efficient, maintenance free, and automatic as possible; (2) arouse interest among friends and neighbors in Northern Montana so that they will gain the necessary confidence to build a system of their own; (3) to cut natural gas heating bill by 65% in each building.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

RENEWABLE ENERGY SOURCES/Solar

491

PROJECT TITLE: Solar Retrofitting Demonstration Project (RAE 101)

INVESTIGATOR: Dennis W. Howard, River Road, Glendive, MT 59330, (406) 365-2261

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$6,000

DURATION: 7/77 - 7/78

LOCATION: MT - Dawson County (Glendive)

DESCRIPTION: Project goals are to: (1) Retrofit an existing single family home with a simple commercially available solar heating system; (2) Demonstrate to the public that solar heating can significantly curtail useage of non-renewable fuels for heating, and save the homeowner money, even though the home was not originally designed with energy conservation in mind; (3) Demonstrate that the average handyman is capable of installing most, if not all, of a solar heating system.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

492

PROJECT TITLE: A Project to Demonstrate the Feasibility of Utilizing Solar Energy for Heating a Pre-existing Residence in North Central Montana (RAE 109)

INVESTIGATOR: Orville N. Oien, C-E Ranch, Inc., R.R. 3, Box 89, Conrad, MT 59425

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$7,276

DURATION: 7/77 - 7/78

LOCATION: MT - Pondera County (Conrad)

DESCRIPTION: This is a solar heating project designed to demonstrate the feasibility and practicality of utilizing solar energy for a pre-existing single family residence in North Central Montana at approximately 48° north latitude. The solar project can be divided into three separate, but integrated systems. The first is the solar heat collection system consisting of a water-ethylene glycol solution circulating from a solar collector unit through copper tubing coiled around water storage tanks, through an expansion tank, and then back to the solar collector. The second system, the heat storage and house heating system, includes eight 120-gallon storage tanks, an 82-gallon electric water heater, and hot water radiators in the living quarters. The third system takes advantage of the hot water ethylene glycol solution that has passed through the solar collector to preheat the water for a conventional hot water heater which is already in operation in the house.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div , Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

493

PROJECT TITLE: Solar Water Heating System Demonstration Project (RAE 110)

INVESTIGATOR: William Harbrecht, 716 Broadway, Helena, MT 59601, (406) 442-4187

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$10,000

DURATION: 7/77 - 7/78

LOCATION: MT - Lewis and Clark County (Helena)

DESCRIPTION: This project is a solar water heating system which will be integrated into a home designed purposely to conserve energy. The benefits derived from this project should be twofold. First and foremost a cost effective solar water system will be operational for public examination. Secondly, people studying the solar system will have an opportunity to tour an architecturally designed energy conservative home.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

494

PROJECT TITLE: Demonstration of a Solar Home Heating System (RAE 111)

INVESTIGATOR: David K. Orndoff, 1063 Breckenridge, Helena, MT 59601, (406) 442-8171

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$5,000

DURATION: 10/77 - 10/78

LOCATION: MT - Lewis and Clark County (Helena)

DESCRIPTION: This solar home heating system is partially modular in design, thus allowing for optimization of the performance of the system by the addition or deletion of component modules. Due to the simple design, upgrading the system is easily done as new developments in the field of solar energy become economically feasible. The system as originally designed is not optimally efficient, but rather, cost effectiveness and practicability take precedence over efficiency. Furthermore, the system has a broad range of applications and can be retrofitted to nearly any dwelling that has an existing conventional heating system.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

RENEWABLE ENERGY SOURCES/Solar

495

PROJECT TITLE: Application of Solar Energy to Heat a House (RAE 112)

INVESTIGATOR: John W. MacDonald, Route 1, Box 53C, Stevensville, MT 59870,
(406) 777-3643FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural
Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$4,314

DURATION: 7/77 - 7/78

LOCATION: MT - Ravalli County (Stevensville)

DESCRIPTION: This project is a demonstration in the application of solar energy to heating a house by retrofitting into an existing hydronic system. In addition, during the summer months, it would provide domestic hot water. Approximately 300 square feet of flat plate solar collectors will be installed, producing heat to be stored in a 1500 gallon heat storage tank, part of the existing system. The solar system would transfer heat, through a heat exchanger, to the heat storage tank. The solar heat alone should be adequate during all but about 100 days, while during that period it would reduce the amount of fuel needed for the wood furnace.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

496

PROJECT TITLE: A Demonstration Project for Solar Home Heating (RAE 119)

INVESTIGATOR: George Mattson, 109 East Main, Bozeman, MT 59715, (406) 587-1240

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural
Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$8,000

DURATION: 7/77 - 7/78

LOCATION: MT - Gallatin County (Bozeman)

DESCRIPTION: This project is a combination of active air collection and passive collection in a single family residence. The house is recessed approximately 2 feet in the ground to keep it low and gain some insulation from the earth. An interior masonry wall serves as passive heat storage and also as a heat sink to balance daytime warming and night cooling. Construction of the solar collector is planned as a wooden, carpenter-built unit. It is intended to use conventional readily available equipment such as an electric furnace to drive the system. The goal is to build an efficient, economical solar house that will also be interesting and attractive, meet the needs of a typical family of four, and speed public acceptance of solar heating.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

497

PROJECT TITLE: Sunspot I -- Demonstration Solar Mobile Home Heating Project (RAE 120)

INVESTIGATOR: James A. Orvis, Route 1, Box 347, Bozeman, MT 59715

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$3,700

DURATION: 7/77 - 7/78

LOCATION: MT - Gallatin County (Bozeman)

DESCRIPTION: This project is to construct and install a retrofit solar heated hot air system for owners primarily of mobile homes. A rock and gravel heat storage bin will be located under the house in a position to feed into the existing blower and ducted heating system. The performance of this system will be evaluated by a three point recording thermograph. The planned project will be such that it can accomodate a methane furnace and a small lean-to greenhouse at a future date. The construction of this system will utilize no special materials or technology unavailable to the layman.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

498

PROJECT TITLE: A Demonstration Solar Home Heating Project (RAE 124)

INVESTIGATOR: Donald E. Peterson, 1 Carriage Way, Missoula, MT 59801

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$7,000

DURATION: 7/77 - 7/78

LOCATION: MT - Missoula County (Missoula)

DESCRIPTION: This is a project to install a solar energy system in a two-story single family dwelling with a daylight basement. It has conventional frame construction with triple-glazed wood windows and insulation factors of R=20 in the walls and R=40 in the ceiling. The solar system is a forced hot air system with 50 tons of rock storage in the basement.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

499

PROJECT TITLE: A Demonstration Solar Home Heating Project (RAE 128)

INVESTIGATOR: Lawrence W. Truchot, Rt. 2 S., Box 937, Great Falls, MT 59401, (406) 452-7443

RENEWABLE ENERGY SOURCES/Solar

499 CONT.

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$7,500

DURATION: 7/77 - 7/78

LOCATION: MT - Cascade County (Great Falls)

DESCRIPTION: The proposed solar system is a water system which basically follows the principle of Thomason but incorporates changes which the applicant feels will improve the system's efficiency and operation without raising the costs excessively. Also, Montana Power Company has agreed to install in the system recording devices to make recordings of where power is being utilized. This will record how much power is required for the hot water heater, the pump for the solar roof, and the backup heating system. They will also monitor the inside and outside temperature. This information will help analyze how efficiently this system is working and how much energy it is saving.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

500

PROJECT TITLE: Solar Shower and Domestic Hot Water Demonstration Project (RAE 141)

INVESTIGATOR/ORGANIZATION: George T. Barber, Conference Minister, Montana Conference of the United Church of Christ, Rocky Mountain College, Kimball Hall, 1511 Polly Drive, Billings, MT 59102, (406) 252-5138

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$1,300

DURATION: 7/77 - 7/78

LOCATION: MT - Camp Memanagist, 25 miles south of Big Timber

DESCRIPTION: This project proposes to do two separate demonstrations. One which will augment the commercial energy source used at the camp, and one which will replace it altogether. Flat-plate collectors for water heating in the lodge/dining hall/dormitory will raise the water temperature between its source and the electric water heater, the object being to reduce the amount of electrical power consumed. A simple solar shower will also be constructed, not only to reduce consumption of conventionally heated water, but to convey in very concrete fashion the lessons of independence (from conventional energy) and dependence (upon climatic, weather, and other environmental conditions).

PUBLICATION: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

501

PROJECT TITLE: Determination of the Most Suitable Materials and Fluids for a Practical Domestic Solar Hot Water System (RAE 142)

INVESTIGATOR/ORGANIZATION: I.R. Shelley, Metallurgical Engineering Dept., Montana College of Mineral Science and Technology, Butte, MT 59601, (406) 792-8321

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$14,812

DURATION: 7/77 - 7/78

LOCATION: MT - Silver Bow County (Butte)

DESCRIPTION: This project is intended to be a development and demonstration project designed to determine the most effective fluids and materials for practical domestic solar and hot water systems. It is anticipated that it will be possible to decide on the most suitable working fluid, method of glazing and metal for collecting cell construction in the Montana environment.

PUBLICATIONS: Quarterly and final reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

502

PROJECT TITLE: Demonstration for the Manufacture of Low-Cost Solar Heating Systems for Mobile Homes (RAE 144)

INVESTIGATOR/ORGANIZATION: Ken Boggs, District 11, Human Resource Council, Inc., 207 East Main, Missoula, MT 59801

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$26,000

DURATION: 7/77 - 7/78

LOCATION: MT - Missoula area

DESCRIPTION: This project will install solar heating systems on mobile homes which utilize an effective plate collector bank which mounts in a vertical position to the south wall of the trailer. District 11 will install 20 of these units at a cost of \$600 per unit on mobile homes of low income families. Unfortunately, most mobile homes are poorly insulated and require substantially more energy to heat per cubic foot than conventionally constructed homes. Although weatherization provides some energy savings for mobile home owners, this type of housing continues to be the most costly from an energy standpoint. Because mobile homes are subject to periodic relocation, the staff of District 11 has designed a modular solar heating system which can be easily dismantled.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

RENEWABLE ENERGY SOURCES/Solar

503

PROJECT TITLE: Low-Income Solar Home Heat Demonstration Project (RAE 145)

INVESTIGATOR/ORGANIZATION: Major Caldwell, Horizon Lodge, 701 South Wisconsin, Conrad, MT 59425

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$50,000

DURATION: 7/77 - 7/78

LOCATION: MT - Pondera County (Conrad)

DESCRIPTION: This project will demonstrate the application of solar energy to domestic water heating in an existing 84 unit, low-income apartment dwelling. The project will consist of a retrofit of the domestic water system to develop a methodology of applying solar energy to existing buildings. Horizon Lodge is a five-story building with roof structure to accommodate equipment. Its location is such that the units would have 100% sun exposure. The proposed system will supply 85% of the present domestic water fossil fuel consumption. Load factors for solar water heating systems are high because of the relatively constant demand for hot water. Thus, solar water heating is an attractive use of solar energy.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

504

PROJECT TITLE: Solar Hot Air Collectors for 20 Low Income Homes (RAE 146)

INVESTIGATOR/ORGANIZATION: District 4 Human Resources Development Council, P.O. Box 1509, Havre, Montana, 59501, (406) 265-6744

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$6,076

DURATION: 7/77 - 7/78

LOCATION: MT - Havre area

DESCRIPTION: This project will develop low-cost, solar hot air, flat plate, double glazed collectors designed to fit the peculiarities of existing housing. These collectors and solar systems will be installed on approximately 20 low income homes. It is anticipated that the installation of these collectors will decrease the home's use of natural gas by as much as 30%. Solar collectors of any type are nearly nonexistent in Northcentral Montana.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

505

PROJECT TITLE: Demonstrations of a Solar Hot Water Heater and a Solar Greenhouse Suitable for Use by Low Income Families (RAE 147)

INVESTIGATOR/ORGANIZATION: Frank Gorsh, Butte-Silver Bow Anti-Poverty Council, Inc., 107 East Granite, Butte, MT 59701, (406) 792-7200

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$4,148

DURATION: 7/77 - 7/78

LOCATION: MT - Silver Bow County (Butte)

DESCRIPTION: This project will construct a solar hot water heater demonstration on a low income person's house in the Butte area, the construction of a solar greenhouse onto the Butte Neighborhood Center, and an evaluation of the effectiveness of these demonstrations over a six month period. If the demonstrations are successful, the Council proposes to attempt to develop an active program to train low income persons in the building and installation of these devices and to install actual devices on several homes in the Butte area.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

506

PROJECT TITLE: Solar Heated Greenhouse for Winter Operation in Montana (RAE 149)

INVESTIGATOR: Peter L. Gobby, 208 S. Willson, Bozeman, MT 59715, (406) 587-1725

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$12,000

DURATION: 7/77 - 7/78

LOCATION: MT - Gallatin County (Bozeman)

DESCRIPTION: This project is for a solar heated greenhouse for winter operation in Montana. This project will demonstrate that commercial greenhouses can be constructed which will maintain adequate growing temperatures with negligible non-renewable energy consumption. We will simultaneously determine whether the increased light intensities due to the reflectors will make up for the short daylight periods and allow the growth of vegetables that would be marginal with normal winter light levels. Although the greenhouse is designed for winter use, summer use is not unreasonable and will be demonstrated also.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

507

PROJECT TITLE: A Project to Retrofit Solar Concentrating Collector System to An Existing Residence (RAE 159)

INVESTIGATOR: William C. Kilby, 3315 5th Ave. N, Great Falls, MT 59401

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$14,100

DURATION: 7/77 - 7/78

LOCATION: MT - Cascade County (Great Falls)

DESCRIPTION: This project will demonstrate a retrofit solar energy system incorporating concentrating collectors as applied to an existing residence. The system is designed and operated at approximately 165°F to 180°F supply water temperature at design outdoor temperature of -20°F. The system must have the high temperature water to be able to transfer enough heat from the finned tube surface to the heated space.

PUBLICATIONS: Quarterly and Final Reports to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

508

PROJECT TITLE: Development of Fluorescent Tube Solar Collector (RAE 160)

INVESTIGATOR: Peter S. Antonioli, P.O. Box 791, Butte, MT 59701, (406) 723-8730

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$5,000

DURATION: 9/77 - 9/78

LOCATION: MT - Silver Bow County (Butte)

DESCRIPTION: Previous work has indicated that the use of discarded fluorescent light tubing can produce a solar collector panel which yields very good operating results. The use of the discarded tubing also indicates that costs can be reduced at the same time a presently discarded resource is utilized. The purpose of this project is four-fold: (1) Carry on further research and development into the use of discarded fluorescent light tubes in the fabrication of solar collector panels; (2) Design and fabricate equipment for the rapid cutting and cleaning of the used tubes; (3) Evaluate various other manifold devices for connection of the tubes; (4) Continue evaluation of various dark fluids and their heat absorbing capacity and ultra-violet degradation.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Division, Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

509

PROJECT TITLE: A Demonstration Project to Develop and Test Five Tracking Parabolic Solar Collectors (RAE 161)

INVESTIGATOR: Ronald Breese, P.O. Box 221, Whitefish, Montana 59937, (406) 862-5273

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$5,000

DURATION: 7/77 - 7/78

LOCATION: MT - Flathead County (Whitefish)

DESCRIPTION: The project goals are to build, test and improve a reflective type solar collector and keep costs per BTU competitive with ordinary flat plate collectors. For higher latitudes, such as Montana 48⁰, the efficiency and output of current flat plate collectors is not sufficient for nearly year round space and water heating. The final system of 10-15 collectors should be sufficient to supply space heat and hot water for the average home most of the year.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

510

PROJECT TITLE: Development of Semicircular Hot Air Solar Collectors (RAE 163)

INVESTIGATOR: Lowell C. Anderson, Pastor, Our Redeemer Lutheran Church, 1311 University, Helena, MT 59601, (406) 442-6884

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$4,000

DURATION: 7/77 - 7/78

LOCATION: MT - Lewis and Clark County (Helena)

DESCRIPTION: The project will research, develop and demonstrate a concentrating hot-air solar collector and system. The concentrating mechanism will be a parabolic or circular reflective surface which will reflect the sun rays onto the heat absorbing surface. It is anticipated that the use of air instead of water as a transfer medium will: (1) eliminate the possibilities of clogging, freezing, and corrosion; (2) eliminate the need to use more expensive materials associated with a water system, e.g., water storage tank, anti-freeze; (3) and decrease the amount of maintenance normally required of a water system.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

RENEWABLE ENERGY SOURCES/Solar

511

PROJECT TITLE: A Solar Powered Radio Repeater System (RAE 168)

INVESTIGATOR/ORGANIZATION: Lee Barrett, Electronics Research Lab., Montana State University, Bozeman, MT 59715

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$5,314

DURATION: 7/77 - 7/78

LOCATION: MT - Gallatin County (Bozeman)

DESCRIPTION: The project involves a repeater communication type system which will be one of the first solar photovoltaic powered amateur radio repeaters in the country. Circuits for data collection by remote control, the total power system of batteries and the solar panels, repeater installation and site development fit under the category of development. The repeater will be an "open" repeater. Any amateur operator having the proper channels will be able to use the repeater. Data sensors will send back periodic data on the system to monitor system functions. Since the repeater is intended to last indefinitely, much data on mountain top solar and weather conditions may be taken for future reference in installations of this type by commercial or governmental agencies.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

512

PROJECT TITLE: A Study of the Radiant Properties of Natural Reflectors to Determine the Feasibility of the Use of Vertical Solar Collectors in Montana (RAE 176)

INVESTIGATOR/ORGANIZATION: John E. Drumheller, Dept. of Physics, Montana State University, Bozeman, MT 59715, (406) 994-3614

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$12,990

DURATION: 7/77 - 7/78

LOCATION: MT - Gallatin County (Bozeman)

DESCRIPTION: This project is a study of the radiant properties of natural reflectors to determine the feasibility of the use of vertical solar collectors in Montana. This project would have significant impact on the possibilities of retrofitting older homes which are not structurally sound for roof type collectors.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

513

PROJECT TITLE: Solar Heating of a Small Commercial Building (RAE 006)

INVESTIGATOR: Phil Morrow, Box 30214, Billings, MT 59107, (406) 656-8191

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation (Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$12,500

DURATION: 1/78 - 1/79

LOCATION: MT - Yellowstone County (Billings)

DESCRIPTION: This project will use 465 square feet of Northrup concentrating collectors for a liquid heating and absorption water chiller air conditioning system. The building, the Fargo Hotel, will be completely renovated in conjunction with this project. It has also been recognized as a historically-significant building by the City of Billings.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

514

PROJECT TITLE: Solar Home Heating Project (RAE 025)

INVESTIGATOR: Peter Rechtfertig, 1030 Harvard Avenue, Billings, MT 59102, (406) 252-7421

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation (Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$1,265

DURATION: 1/78 - 1/79

LOCATION: MT - Yellowstone County (Billings)

DESCRIPTION: This is a retrofit project employing a passive solar design with 98 square feet of southerly exposed window area. The window area will be covered with insulated shutters to reduce heat loss during cold, cloudy days and at night. Proving the value of the system will result in making a simple, low technology approach available for new and existing construction. Part of the installation is the design or modification of the duct work to draw warm air from the rooms with the windows, through the furnace fan, and distribute it through the house.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

515

PROJECT TITLE: Solar Home Heating and Domestic Hot Water Preheating Retrofit System (RAE 029)

INVESTIGATOR: Max Leighty, 2212 Bullard Street, Miles City, MT 59301, (406) 232-1568

RENEWABLE ENERGY SOURCES/Solar

515 CONT.

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$3,245

DURATION: 1/78 - 1/79

LOCATION: MT - Custer County (Miles City)

DESCRIPTION: This is a retrofit project employing a home-built, active solar air heating system (270 square feet), rock storage, and a domestic hot water preheating system. The entire project will be built by the applicant. It will include outfitting five storm windows, enclosing entranceways from outside, and adding roof insulation. The storm window cost is not funded by this grant.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

516

PROJECT TITLE: Solar Home Heat and Domestic Hot Water Preheating/Heat Pump Backup (RAE 047)

INVESTIGATOR: Norm Sulenes, 2218 Fairview Place, Billings, MT 59102, (406) 259-7464

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$10,760

DURATION: 2/78 - 2/79

LOCATION: MT - Yellowstone County (Billings)

DESCRIPTION: This project involves the use of a 360 square foot passive collector system with liquid storage, liquid domestic hot water preheating system, and a heat pump for backup heating. The working fluid in this passive collector design will be freon.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

517

PROJECT TITLE: Alternative Energy Systems for Mobile Homes (RAE 048)

INVESTIGATOR: Charless Fowlkes, 1820 S. 7th Ave., Bozeman, MT 59715, (406) 587-3779

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$25,000

DURATION: One year grant starting in early 1978.

LOCATION: MT - Gallatin County (Bozeman)

517 CONT.

DESCRIPTION: This project will involve a side-by-side comparison of two well-insulated mobile homes, one using a liquid solar heating system while the other will use an air system. Since space is limited in a mobile home, the storage will be built into the pad for the trailer located directly underneath it. This will enable the storage to be easily coupled to the hot air heating system that is conventional in most mobile homes currently being produced. All components of this system will be heavily monitored and analyzed in a scientific manner. The final results of this project will be a plan for two types of solar heating systems that can be built and integrated with a mobile home. System plan, performance and cost will be known in advance for someone wishing to build a similar system.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

518

PROJECT TITLE: A Laboratory Heated by Solar Energy (RAE 051)

INVESTIGATOR/ORGANIZATION: Charles Herndon, Mineral Research Center, Montana Tech Alumni Foundation, Butte, MT 59701, (406) 792-8321

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$13,570 DURATION: One year grant starting in early 1978.

LOCATION: MT - Silver Bow County (Butte)

DESCRIPTION: This project will investigate in a scientific manner, the efficiency of a liquid to-air heat pump, coupled with a liquid solar-heating-system. The performance of several different kinds of liquid collectors will also be monitored. All equipment will be used to heat an office area in the Mineral Research Center. Two goals of the project are (1) a properly designed solar energy utilization system affordable by home-owners; and (2) a computer program for sizing and selection of components for the whole system.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

519

PROJECT TITLE: Residential Solar Water Heating System (RAE 054)

INVESTIGATOR: Barbara Clowers, 700 7th Ave. N, Great Falls, MT 59401

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$2,800 DURATION: 2/78 - 2/79

LOCATION: MT - Cascade County (Great Falls)

RENEWABLE ENERGY SOURCES/Solar

519 CONT.

DESCRIPTION: This project is for a retrofit solar system for domestic water heating. The solar heating system will incorporate flat-plate hydronic collectors with a pre-heating water tank to be used with the existing water tank.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

520

PROJECT TITLE: Active Solar Hot Water Heating of a Solar Greenhouse (RAE 060)

INVESTIGATOR: James Orvis, Route 1, Box 347, Bozeman, MT 59715

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$616.00 DURATION: One year grant starting in early 1978.

LOCATION: MT - Gallatin County (Bozeman)

DESCRIPTION: This project will demonstrate a low cost, 84 square foot, home-built, greenhouse that will be used to extend the growing season late into the fall and start it early in the spring. It will use 24 square feet of liquid collectors and a 220 gallon storage area to supply night time heating. This will provide an example for those people who wish to grow a large share of their own vegetables and thus reduce the demand for energy intensive, out-of-state produce.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

521

PROJECT TITLE: Solar Heated Greenhouse (RAE 061)

INVESTIGATOR: Stan Steadman, 320 E. Power St., Glendive, MT 59330

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$1,240 DURATION: 2/78 - 2/79

LOCATION: MT - Dawson County (Glendive)

DESCRIPTION: This project will demonstrate a 135 square foot attached greenhouse similar to those built in a Solar Sustenance Project in New Mexico. Heat will be stored for night time use in rows of 55 gallon barrels. This greenhouse should produce vegetables from early spring to late fall for this family.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

522

PROJECT TITLE: Solar Space Heating in Fort Benton United Methodist Church
(RAE 062)

INVESTIGATOR: Brian Wood, Box 153, Loma, MT 59460, (406) 739-4344

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$9,380 DURATION: One year grant starting in early 1978.

LOCATION: MT - Chouteau County (Loma)

DESCRIPTION: This project will demonstrate a 2,000 square foot liquid, trickle-type collector system that will be retrofit onto a church. The church will upgrade its building insulation to make it a more energy efficient structure. A major goal of this demonstration project is to illustrate that homeowners, organizations with heated facilities, contractors, and carpenters can build and install low cost and practical solar space heating systems without the mystery, complexity and apprehension usually associated with this subject.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

523

PROJECT TITLE: Solar Heated Swimming Pool in Shelby, Montana (RAE 078)

INVESTIGATOR: c/o Rae Kalbfleisch, City of Shelby, P.O. Box 518, Shelby, MT 59474

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$36,800 DURATION: One year grant starting in early 1978.

LOCATION: MT - Toole County (Shelby)

DESCRIPTION: This project will demonstrate a large, municipal solar-heated swimming pool that can be used all year long. The proposed solar system will consist of a series of copper collectors situated on the roof of the pool. The heated water would be stored in either a tank or be pumped directly in the pool to heat the water, thus continuous solar heating could be achieved the entire 12 months of the year.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

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524

PROJECT TITLE: Montana Solar-Assisted Water Heating Facility and Instrumentation Program (RAE 085)

INVESTIGATOR/ORGANIZATION: Pacific Power and Light Co., P.O. Box 250, Kalispell, MT 59901, (406) 755-7461

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$3,000 DURATION: One year grant starting in early 1978.

LOCATION: MT - Flathead County (Kalispell)

DESCRIPTION: This project will demonstrate a premanufactured 54 square foot solar domestic hot water preheating system. This system will be heavily monitored by the applicant and should provide useful information as to the economic feasibility of this type of system in the Kalispell area. This program will complement the already existing network of instrumented solar heating facilities in PP&L's service area.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

525

PROJECT TITLE: Weather Station for Solar Heights Subdivision (RAE 086)

INVESTIGATOR: Thomas Stewart, 8945 Douglas Circle, Helena, MT 59601, (406) 458-9729

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$3,000 DURATION: One year grant starting in early 1978.

LOCATION: MT - Lewis and Clark County (Helena)

DESCRIPTION: The project is for weather measuring equipment and a small solar heated building to house the instruments. The weather station is one phase planned for a systematic development of a major subdivision in the Helena area which is being designed and planned for persons specifically interested in constructing homes that will use solar or other alternative energy methods. The weather station will be located in the subdivision. The funding will be used to help stimulate the development of the subdivision for solar residences.

526

PROJECT TITLE: Construction and Installation of Solar Hot Water Systems (RAE 097)

INVESTIGATOR/ORGANIZATION: c/o Ken Boggs, District 11 Human Resources Development Council, 207 E. Main, Missoula, MT 59801, (406) 728-3710

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FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$15,000 DURATION: One year grant starting in early 1978.

LOCATION: MT - Missoula area

DESCRIPTION: This project will retrofit six, low-income homes with active, liquid, solar, domestic, hot water preheating systems. This is part of a continuing effort by District 11 to promote development of appropriate technology and to make the benefits immediately available to low-income households.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

527

PROJECT TITLE: Solar Home Monitoring Program

INVESTIGATOR/ORGANIZATION: Yet to be determined.

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$20,000. (An additional \$10,000 will be available if the need arises before the next group of grants are awarded in 1978.)

DURATION: Undetermined

LOCATION: MT

DESCRIPTION: The Alternative Energy Advisory Council recommended that the Montana Department of Natural Resources and Conservation write a description of the type, accuracy, and general cost of equipment necessary to undertake a serious scientific study of three to five solar heated homes funded under the Alternative Renewable Energy Sources Program. Data reduction and processing costs using the proposed equipment should be included. This description would be sent to qualified interested parties who in turn will propose monitoring programs necessary to accomplish the Department's intent.

528

PROJECT TITLE: Billings Shipping Corporation -- Solar Heating Demonstration Project

INVESTIGATOR/ORGANIZATION: Ed Barrett, Billings Shipping Corporation, Box 30216, Billings, MT 59107, (406) 252-3868

FUNDING AGENCY: U.S. Energy Research and Development Administration, Division of Solar Energy; also private funding.

FUNDING AMOUNT: \$59,900 (ERDA); Approx. \$15,000 (private)

DURATION: 2/77 - 11/77

LOCATION: MT - Yellowstone Co. (Billings)

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DESCRIPTION: The Billings Shipping Corporation solar heating project is one of 80 such projects funded by the Energy Research and Development Administration to help demonstrate how solar energy can heat and cool commercial buildings. This solar energy system will be used on a new office building which will be part of a freight distribution facility. The total project involves 46,976 square feet of new construction of which 4,900 square feet is the office portion. Water to water flat plate solar collectors will be used to provide space heating for an office building. The collectors will furnish heated water to an air handling unit if the occupied space is requiring heating or to a water storage tank if the space temperature is satisfied. An outdoor heat rejection unit will be used to prevent the water-anti-freeze solution circulated through the collectors from exceeding 200°F. Heat from the storage tank will be used when the collectors are not operating.

529

PROJECT TITLE: Solar Reliant Greenhouse Project -- Community Services Administration, Community Food and Nutrition Program

INVESTIGATORS/ORGANIZATION: Jeff Rupp, Jim Nolan, Human Resources Division, Montana Dept. of Community Affairs, 1424 9th Ave., Helena, MT 59601, (406) 449-3420

FUNDING AGENCY: Community Services Administration; volunteers, and citizen organizations

FUNDING AMOUNT: FY77 \$131,000 (CSA); \$20,000 (matching volunteer effort and senior citizens)

DURATION: 1/77 - 10/77

LOCATION: MT - Statewide

DESCRIPTION: Under this grant Montana's Human Resource Development Council's are constructing solar reliant greenhouses to address more cost-effective ways for food delivery service systems. Examples are senior citizen centers and school hot lunch programs. This program must benefit low-income persons.

RENEWABLE ENERGY SOURCES

3.5 WIND

RENEWABLE ENERGY SOURCES/Wind

530

PROJECT TITLE: Windmill Shelterbelts (RAE 20)

INVESTIGATOR/ORGANIZATION: V. Hugo Schmidt, Department of Physics, Montana State Univ., Bozeman, MT 59715, (406) 994-3614

FUNDING AGENCY: State of Montana (Energy Planning Div., Montana Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$7,346

DURATION: 11/76 - 11/77

LOCATION: MT - Gallatin County (Bozeman)

DESCRIPTION: This project is concerned with electrical generators and alternators used with small wind systems, and conversion of their output to 60 Hz ac which can be fed into existing power grids. The major task of this project will be continued development and testing of the synchronous inverter on which work has commenced. This device is based on an SCR (Silicon Controlled Rectifier) bridge. An electronic control of the SCR firing angle will be devised which will adjust the load presented by the inverter to the generator, in order to control the wind rotor rpm so as to obtain nearly maximum possible power output at all wind speeds. An estimate will be made of the cost of the inverter in quantity production. A mostly completed wind generation system will be finished, and will be used in field tests of the inverter.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

531

PROJECT TITLE: Wind Energy System for an Existing Residential House -- Phase I (RAE 35)

INVESTIGATOR/ORGANIZATION: Drapes Engineering Firm, 20 Eklund Building, Great Falls, MT , (406) 452-9558

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$5,093

DURATION: 12/76 - 12/77 (Completed)

LOCATION: MT - Cascade County (near Great Falls)

DESCRIPTION: Phase I of the Wind Energy Demonstration Project will consist of a meteorological confirmation of the magnitude of the wind resource at the proposed site. (Phase II which may be funded at a later date, would consist of the actual procurement of equipment, installation and monitoring of performance.) Phase I will consist of the following steps: (1) the selected hill-top will be instrumented in order to positively establish the magnitude of the wind energy resource; (2) following a minimum measuring period of one month, a decision regarding the future course of the project will be made: (a) either end project because of insufficient wind energy; (b) continue the meteorological measurements if one month measuring period is considered insufficient to establish a reliable correlation with Weather Bureau data; (c) continue project if recorded data and correlation with long-term data indicate

RENEWABLE ENERGY SOURCES/Wind

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site is sufficiently windy; (3) carry out an analytical estimation of the wind plant energy production.

PUBLICATIONS: A final report has been submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

532

PROJECT TITLE: Paddlewheel-Type Windmill (RAE 39)

INVESTIGATOR: LeRoy Gustafson, Box 1168, Cutbank, MT 59427, (406) 873-2390

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$4,800

DURATION: 11/76 - 11/77 (Completed)

LOCATION: MT - Glacier County (Cutbank)

DESCRIPTION: This project will design a paddlewheel with a deflector on the lower half to prevent the wind from hitting the balloon which is moving into the wind. Wind tunnel experiments will be conducted to determine the most economical position and size of the deflector, number of blades, and shape of the blades. The model is scaled up and 1' x 20' windmill will be constructed. The purpose of this experiment is to design a windmill with a slow tip speed, that doesn't need to be feathered, that can be made fairly large without special equipment, and can be made of junk material, and be economical. Unlike the fan blade wind generator, the paddlewheel turns with the wind. For this reason it can't turn much faster than the speed of the wind even when free wheeling. Other windmills turn at right angles to the wind. When they have a small load they continue to accelerate till self-destruction -- therefore they need to be feathered. A slower blade allows the use of heavier materials, such as steel. This design should be especially useful to Montana farmers and ranchers. It can be built with no outside help and most of the materials used can be found at low cost.

PUBLICATIONS: A Final Report has been submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

533

PROJECT TITLE: A Domestic Sized Wind-Electric System for Rural Montanans (RAE 52)

INVESTIGATOR/ORGANIZATION: Bill Delp, Independent Power Developers, Inc., Box 1467, Noxon, MT, (406) 847-2211

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$64,256

DURATION: 12/76 - 12/77

LOCATION: MT - Chouteau County (Highwood)

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DESCRIPTION: The objective of this project is to construct a wind-electric generation system on a farm near Highwood, Montana which will be capable of meeting the power requirements of an all electric household on that site during a minimum of 90% of any given test year. To accomplish this objective, a wind-electric generation system having a maximum output of 20 kilowatts in 25 mph winds with a start-up wind speed requirement of 6 mph is to be constructed.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

534

PROJECT TITLE: Integrated Wind Power Systems (RAE 201)

INVESTIGATORS/ORGANIZATION: V. Hugo Schmidt and Richard Rosa, Dept. of Physics, Montana State Univ., Bozeman, MT 59715, (406) 994-3614

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$19,640

DURATION: 7/77 - 7/78

LOCATION: MT - Gallatin County (Bozeman)

DESCRIPTION: This project will continue the development of wind generation systems which will be integrated into the existing electrical power grid. Development of synchronous inverters which change direct current from wind generators into alternating current synchronized with the line frequency, will be continued. Two types of synchronous inverter systems will be studied, based on silicon-controlled rectifiers (SCRs) and transistors respectively. The goals will be to improve efficiency and current waveform, to design the inverters to present the proper load to the generator for various wind speeds, and to reduce cost. Three types of ducted windmill systems, consisting of fixed barriers arranged to increase air velocity to the rotors, will be developed and tested. These systems will be designed to be applicable to windmill shelterbelts as well as to individual use. The synchronous inverters would also be applicable to solar or small hydro-electric direct current generating systems. (NOTE: This work is closely related to "Windmill Shelterbelts," Project No. 530.)

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

535

PROJECT TITLE: Two Kilowatt Dunlite Home Wind Generator System (RAE 204)

INVESTIGATOR/ORGANIZATION: Drapes Engineering, 2020 Eklund Bldg., Great Falls, MT 59402, (406) 452-9558

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

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FUNDING AMOUNT: \$19,375

DURATION: 7/77 - 7/78

LOCATION: MT - Cascade County (Great Falls)

DESCRIPTION: This project will demonstrate the operation of a wind-powered electric generating system which works in conjunction with the existing power grid. This system configuration displays several marked advantages over traditional electric energy storage in batteries. Since the network provides back-up energy, no storage is required. The heavy investment of money, materials and energy in batteries is not necessary and the net energy gain of the system is improved. No change in house wiring is required. This system makes use of the power distribution network the Federal government has already subsidized. All of the wind-generated energy is used either in the house or somewhere else in the network. Thus, another electric producing fuel, such as coal or water, is replaced by renewable wind energy.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

536

PROJECT TITLE: Wind Generated Electric Hot Water Preheater Demonstration (RAE 205)

INVESTIGATOR/ORGANIZATION: Wayne Lersback, Superintendent, School District #3 and 3B, Cascade, MT, (406) 468-2267

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$10,000

DURATION: 9/77 - 9/78

LOCATION: MT - Cascade County (Cascade)

DESCRIPTION: The proposed system would consist of three wind powered electric generators providing approximately 80 percent of the annual domestic water heating demand for the Cascade School Building. Water heating would be accomplished by use of DC powered electric emersion heaters, eliminating the need for conversion to AC. Storage and utilization of a variable wind energy system is made possible by allowing the existing hot water tank to function as a heat storage device.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

537

PROJECT TITLE: Wind Electric Generator Research and Demonstration Project (RAE 206)

INVESTIGATOR/ORGANIZATION: Robert Leo, Electronics Research Laboratories, Montana State Univ., Bozeman, MT 59715

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

537 CONT.

FUNDING AMOUNT: \$8,035

DURATION: 7/77 - 7/78

LOCATION: MT - Gallatin County (Bozeman)

DESCRIPTION: This project will develop a wind powered electric generating system, especially designed and adapted for use in Montana's severe winter environment and for Montana applications. From the standpoint of basic research, several results relative to wind electric systems would be produced. (1) Support (or not) of the concept of the use of unfeathered propeller systems; (2) Support (or not) of the concept of the use of braked systems; (3) Demonstration of a simple modern electronic control system; (4) That a reliable low cost wind electric system is feasible for Montana mountain top applications.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

538

PROJECT TITLE: Winco 200 Watt Home Wind Generator Demonstration Project (RAE 209)

INVESTIGATOR: John F. Kelly, Star Route 1, Libby, MT 59923

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$3,500

DURATION: 8/77 - 8/78

LOCATION: MT - Lincoln County (Libby)

DESCRIPTION: This project is to install a 200-watt generator, which comes with a 50-foot tower, a 30-foot tower which supports the generator, and a smaller tower, and two 200 amp-hour deep cycle batteries. The wind generator would be installed approximately 50 feet from the house and would connect to already existing electrical wiring in the house. Also on the tower would be installed a recording and a monitor and direction indicator so that wind speed and direction would be recorded.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

539

PROJECT TITLE: Wind Monitoring Project (RAE 202)

INVESTIGATOR: John Gordon, Cascade, MT 59421

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$2,000 DURATION: One year grant starting in early 1978.

LOCATION: MT - Cascade County (Cascade)

RENEWABLE ENERGY SOURCES/Wind

539 CONT.

DESCRIPTION: This is a project to monitor the wind power generation potential at a farm site 19 miles south of Cascade, Montana. The ultimate intent of this project is to install and operate a wind-powered electric system which will provide renewable energy to the residence. However, this proposal only includes the wind monitoring because it is necessary to establish wind power generation potential prior to investment in equipment. Instrumentation capable of measuring wind power generation potential will be operated for a minimum of 10 months. The recorded data will be analyzed from the standpoint of power generation at the site and an estimation of the theoretical energy output of several wind powered electric systems will be made.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

540

PROJECT TITLE: Wind Energy Research Project for the Fort Belknap Indian Reservation (RAE 204)

INVESTIGATOR/ORGANIZATION: Ft. Belknap Planning Program, Ft. Belknap Agency, R.R. 1, Box 70, Harlem, MT 59526

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$2,000 DURATION: One year grant to start in early 1978.

LOCATION: MT - Fort Belknap Reservation

DESCRIPTION: This project will assess the wind potential at two sites: one near a small tribal building in Hayes and the other at a reservoir. The site in Hayes will be for possible wind electric generation. The reservoir location will study wind water pumping potential. Since there is evidence that this particular location does get a considerable amount of wind, it is felt that a wind energy research project would be beneficial in seeking an alternative energy source for Fort Belknap Reservation.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

541

PROJECT TITLE: Homemade Wind Powered Air Compressor (RAE 206)

INVESTIGATOR: William M. Stockton, Grassrange, MT 59032

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$2,000 DURATION: 2/78 - 2/79

LOCATION: MT - Fergus County (Grassrange)

541 CONT.

DESCRIPTION: This project will demonstrate a homemade savonius type windmill that will be used to power an air compressor. The use of compressed air is one of the cleanest ways to store energy. Air motors can be used by themselves, and in addition be used to power small electric generators, which can be activated at will.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

542

PROJECT TITLE: Technical Feasibility Study of a Wind Energy Conversion System Based on the Tracked Vehicle-Airfoil Concept

INVESTIGATORS/ORGANIZATION: H.W. Townes, E.H. Bishop, R.E. Powe, Dept. of Mechanical Engineering, Montana State Univ., Bozeman, MT 59715

FUNDING AGENCY: U.S. National Science Foundation FUNDING: \$55,000

DURATION: 6/73 - 6/74 (Completed) LOCATION: MT

DESCRIPTION: The objective of this project was to evaluate the technical feasibility of a wind energy conversion system based on the tracked vehicle-airfoil concept. Specific goals include: (1) Establishment of performance specifications for the major system components and identification of interface requirements; (2) Formulation of alternative designs to meet the foregoing conditions; (3) Performance of an engineering analysis of these systems, identification of major strengths and weaknesses, and selection of a promising design; (4) Initiation of a detailed systems design, including economic considerations, to establish technical feasibility. This project is concerned with assessing the technical feasibility of a novel momentum-interchange device which involves vertical airfoils mounted on carriages which move on a horizontal closed track system.

PUBLICATIONS: (1) Report NSF/RANN/SE/G1-39415/PR/73/1; NSF/RANN/SE/G1-39415/PR/73/3; NSF/RANN/SE/G1-39415/PR/74/3; (2) R.E. Powe, H.W. Townes, et. al., Wind Energy Conversion, presented at the Rocky Mountain Science Council Energy Symposium, Albuquerque, NM, March 1974; (3) R.E. Power, H.W. Townes, Wind Energy Conversion System Based on the Tracked-Vehicle Airfoil Concept, presented at the 9th Intersociety Energy Conversion Conference, San Francisco, August 1974.

RENEWABLE ENERGY SOURCES

3.6 WOOD

RENEWABLE ENERGY SOURCES/Wood

543

PROJECT TITLE: Development and Demonstration of the Use of Wood in Home Heating (RAE 40)

INVESTIGATOR: Robert M. Zychek, Route 1, Box 89A, Bozeman, MT 59715, (406) 388-4360

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$1,000 DURATION: 5/77 - 5/78 (Completed)

LOCATION: MT - Gallatin County (Bozeman)

DESCRIPTION: This project will primarily develop and demonstrate use of wood in home heating and will conduct a limited amount of research. The system will make use of a fireplace as an auxiliary, and possibly, as a primary resource in a home equipped with hot water heating.

PUBLICATIONS: A Final Report was submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

544

PROJECT TITLE: The Use of Wood as a Fuel for Heating a Single Family Dwelling Using Water for Heat Distribution in Conjunction With a Heat Storage Unit (RAE 74)

INVESTIGATOR/ORGANIZATION: S. Richard Hagan, Dept. of Industrial Eng., Montana State Univ., Bozeman, MT 59715, (406) 587-8808

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$4,000 DURATION: 12/76 - 12/77

LOCATION: MT - Gallatin County (near Bozeman, Bridger Canyon)

DESCRIPTION: The major purpose of the project is to study the feasibility of using wood as a heat source in conjunction with a hot water distribution system incorporating a heat storage unit. The project will consider how to heat a single family dwelling using a wood fired furnace emphasizing home owner convenience and more important, a reduction in the amount of air pollutants produced through wood combustion. Care will be taken to develop a system which is in the economic reach of the average Montana home owner.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

RENEWABLE ENERGY SOURCES/Wood

545

PROJECT TITLE: Automatic Wood Burning Furnace Development and Demonstration Project (RAE 301)

INVESTIGATOR: Bill Delp, Independent Power Developers, Inc., Box 1467, Noxon, MT 59853

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$6,968

DURATION: 7/77 - 7/78

LOCATION: MT - Sanders County (Noxon)

DESCRIPTION: This project is to construct and demonstrate a wood burning furnace at IPD near Noxon, Montana which will efficiently provide winter heat for a building housing an area of 2,560 square feet in an air space of 44,800 cubic feet. The wood heater which IPD proposes to build and demonstrate is of the basement furnace variety but on a residential scale. It is hoped that this furnace can equal or surpass the combustion efficiency of any wood burner on the market today.

PUBLICATIONS: Quarterly and final reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

546

PROJECT TITLE: Monitoring of a Coal/Wood Fireplace Water Home Heating System (RAE 303)

INVESTIGATOR/ORGANIZATION: Alvin G. Fiscus, Dept. of Microbiology, Montana State Univ., Bozeman, MT 59715, (406) 994-2901

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$600.00

DURATION: 7/77 - 7/78

LOCATION: MT - Gallatin County (Bozeman)

DESCRIPTION: This project will attempt to make existing fireplaces more efficient by utilizing a cast iron steam radiator in the fireplace box and circulating water through the radiator. Two parameters will be used to measure the efficiency of the system. One will determine the rate of heat dissipation with one zone open, relative to time, of the boiler temperature with and without the utilization of the adjunct system. The second will compare the volume of natural gas used for the past two years for the weekend days of October through March to that utilized during the test period. It is anticipated that this project will decrease markedly the usage of a non-renewable fuel, natural gas, which is in extremely short supply and will recycle discarded cast iron radiators.

PUBLICATIONS: Quarterly and final reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

547

PROJECT TITLE: Double Wood Stove Heating System Demonstration Project (RAE 304)

INVESTIGATOR: Leland E. Smith, 2425 Chaparral Road, Helena, MT 59601

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$2,837

DURATION: 7/77 - 7/78

LOCATION: MT - Lewis and Clark County (Helena)

DESCRIPTION: This project will install several wood burning units and energy savers as a demonstration to show people how they can heat with wood efficiently.

PUBLICATIONS: Quarterly and final reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

RENEWABLE ENERGY SOURCES

3.7 INTEGRATED SYSTEMS

RENEWABLE ENERGY SOURCES/
Integrated Systems

548

PROJECT TITLE: Solar/Wood Heating System (RAE 45)

INVESTIGATOR: Charless W. Fowlkes, 5 Faculty Court, Bozeman, MT 59715, (406) 587-0192

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$10,000

DURATION: 11/76 - 11/77

LOCATION: MT - Gallatin County (Bozeman)

DESCRIPTION: This project is for a solar heated residence utilizing supplemental wood heating to be built in Bozeman. The house is a passive solar wall design and will be a demonstration project. Calculations indicate that over 90% of the heating load of the house will be met by the solar/wood system. Solar heating of the service water is also included in the design. The design incorporates energy conserving features and alternative energy utilization systems. The solar wall concept has been refined to fit the environmental requirements of Montana. The philosophy of the entire design has been to make the house and the alternative energy systems as simple as possible.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

549

PROJECT TITLE: An Integrated Renewable Energy System -- Solar, Wind, and Wood (RAE 61)

INVESTIGATOR: Thomas M. Power, Bass Creek Commune, Route 2, Stevensville, MT (406) 243-4586

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$12,095

DURATION: 11/76 - 11/77

LOCATION: MT - Ravalli County (Stevensville)

DESCRIPTION: This project proposes to build an energy system appropriate for homes and small commercial buildings which integrates into one system three renewable energy systems: wood, solar, and wind. This demonstration project will attempt to show that the often discussed physical and environmental limitations on wind, solar, and wood energy in W. Montana are neither uniformly applicable to all sites in W. Montana nor insurmountable using current, reasonable, low-level practical technology. All three of these sources of renewable energy will charge a common heat storage system which in turn will be drawn upon to heat the building. This effectively integrates them into one system which is not dependent upon one source of renewable energy.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

RENEWABLE ENERGY SOURCES/
Integrated Systems

550

PROJECT TITLE: Solar Home Heating Demonstration Project (RAE 100)

INVESTIGATOR: Philip D. Pallister, M.D., Jaybird Ranch, Boulder, MT 59632,
(406) 225-3648

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$8,000

DURATION: 7/77 - 7/78

LOCATION: MT - Jefferson County (Boulder)

DESCRIPTION: This project proposes to use sun and wood as a renewable energy source to provide the majority portion of heating and domestic hot water supply of a large, well-insulated rural home utilizing wood fireplace boilers. Renewable energy sources which will be utilized are largely solar energy to be collected by hot water panels, and wood to be burned in fireplaces to heat water jackets. Wind energy will be utilized as a limited alternative that may be used to store either electrical or heat energy. Solar energy will be used to heat a greenhouse. (NOTE: Funding is limited to solar part of the project.)

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

551

PROJECT TITLE: A Solar and Wood Heat Demonstration in the Denny Driscoll Boys Home (RAE 132)

INVESTIGATOR/ORGANIZATION: J.F. Finnegan, Director, Denny Driscoll Boys Home, P.O. Box 3093, Butte, MT 59701

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$30,000

DURATION: 9/77 - 9/78

LOCATION: MT - Silver Bow County (Butte), Jefferson County (Whitehall)

DESCRIPTION: The Boys Home proposes to install a Hippert Wood Burning Furnace at the main Denny Driscoll Boy's Home in Butte, Montana, a Materials Consultants, Inc. (MCI) solar flat plate air collector to supply heat for the office building and the Daisy Brasier Honor College at the Butte location, and an MCI collector with a Hippert Wood Burning Furnace as a back-up system at the Boy's ranch in Whitehall.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

RENEWABLE ENERGY SOURCES/
Integrated Systems

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PROJECT TITLE: A Demonstration Integrated Solar System Project (RAE 133)

INVESTIGATOR: Anthony J. Terzo, Jr., 820 Hilda Ave., Missoula, MT 59801,
(406) 549-3168

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$10,000

DURATION: 10/77 - 10/78

LOCATION: MT - Missoula County (Missoula)

DESCRIPTION: This project will demonstrate that the sun can be used as the major energy source for space heating and cooling and domestic water heating whenever possible. It will also show that wood fuel, whether as a backup system to a solar heater, or as the sole heat source, can be used much more efficiently and conveniently than is presently being done, and with less pollution. The major innovative concepts that will be demonstrated by this project are: (1) A hillside air-type solar collector, located below the heat storage bin, which turns itself on and off and circulates air by convection; (2) A rock and concrete heat storage bin of unique design which utilizes the principles of convection to store and release heat obtained from a flat plate solar collector and/or from a wood burning furnace; (3) A wood burning furnace which incorporates self-regulating features which maintain efficient combustion with minimum heat loss up the chimney; (4) The complete solar/wood heating system uses the principles of convection and is thus immune to power failures and energy shortages; (5) The rooftop, water type collector heats water for domestic uses and for the pool. It uses no more electricity than would be necessary to operate the pool filter pump; (6) The same rooftop solar collector also operates automatically as an exhaust fan to aid summer cooling using no energy other than sunlight.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

553

PROJECT TITLE: Passive Solar Demonstration Project (RAE 134)

INVESTIGATOR: John Duffield, Route 5, Pattee Canyon, Missoula, MT 59801, (406) 243-4646

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$9,640

DURATION: 7/77 - 7/78

LOCATION: MT - Missoula County (Missoula)

DESCRIPTION: This is a project to build a passive solar demonstration, appropriate to homes or small commercial buildings. The proposed integrated renewable energy system will include a solar trombe wall, clerestory, insulating curtains, insulation, wood furnace and fireplace, and solar water heater.

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Integrated Systems

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While the basic elements of this system have been separately explored by others, the integration of space and hot water heat and interior illumination in a single solar-wood system is an innovation.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

554

PROJECT TITLE: A Demonstration Project of Solar and Wood Energy (RAE 138)

INVESTIGATOR: Gregory N. Cunniff, 742 -- 33 B Ave., NE, Great Falls, MT 59404

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$16,850

DURATION: 7/77 - 7/78

LOCATION: MT. - Cascade County (Great Falls)

DESCRIPTION: This project will demonstrate the feasibility of applying a retrofit combination of solar space heating with a wood backup and incorporating storage for a total renewable energy heating system. This system will consist of a retrofit solar space heating system using flat-plate air collectors and a gravel storage tank. The energy delivered by the solar system will supply approximately 62% of the present heating demand. The wood system will supply an additional 23% by burning six cords of wood per year at an efficiency of 40% to yield approximately 85% of the total heating demand supplied by renewable energy. The remainder of the heating demand will be supplied by the existing natural gas furnace.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

555

PROJECT TITLE: A Solar and Wind Home Heating System Demonstration Project (RAE 139)

INVESTIGATOR: Otis B. Johnson, Box 157, Turner, MT 59542, (406) 379-2323

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$7,000

DURATION: 7/77 - 7/78

LOCATION: MT - Blaine County (Turner)

DESCRIPTION: This project proposes to produce a home that will demonstrate both the feasibility and the practicability of using a combination of solar heating and wind power generated electricity to heat water for both heating and hot water. It is anticipated that the combined system should produce more than 75% of the heat needed to keep a home comfortable in a cold Montana winter.

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PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

556

PROJECT TITLE: Solar, Wind, and Wood Home Heating System Demonstration Project (RAE 140)

INVESTIGATOR: Richard L. Dill, Route 2, Box 50A, Stevensville, MT 59870, (406) 777-3168

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$6,361

DURATION: 7/77 - 7/78

LOCATION: MT - Ravalli County (Stevensville)

DESCRIPTION: The project is an integrated system of solar, wind, and wood. Wood is plentiful in the location and with proper forest management should always be. It is an ideal backup to solar and wind in this part of the country. Some specific design considerations are: (1) To design a small efficient well insulated living space; (2) To design energy requirements to coincide with use; (3) To orient the dwelling to make maximum use of existing alternative energy; (4) Architecture should reflect first energy usage and efficiency, secondly aesthetics.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

557

PROJECT TITLE: A Windborn Self-Sufficient Solar Greenhouse Project (RAE 150)

INVESTIGATOR: John D. Brown, Box 216, Circle, MT 59215, (406) 485-2180

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$12,500

DURATION: 7/77 - 7/78

LOCATION: MT - McCone County (Circle)

DESCRIPTION: The windborn self sufficient solar greenhouse is a renewable energy project integrating not only wind and solar energy but also biological processes. As such, it addresses a variety of questions concerning greenhouse design management and energy budgeting. The following points will be addressed:
Research: (1) What is the relationship between wind speed and solar intensity? Can an integrated system effectively address the problems of energy variation and storage? (2) To what extent are interior climate fluctuations controllable given the energy inputs and control mechanisms specified, and what effects will all this have on plant viability? (3) Production of heat, CO₂ and fertilizer

RENEWABLE ENERGY SOURCES/ Integrated Systems

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will be by aerobic digestion. These by-products will be measured and the characteristics of their interactions with plant life analyzed; (4) Energy inputs and requirements will be monitored on a daily basis; (5) Labor input will be noted and the economic/net energy aspects tabulated at the end of the year.

Development: We intend to develop an integrated growing environment powered by: (1) Direct solar radiation. Heat will be stored passively in water containers, earth and concrete. (2) Wind powered electricity generation. The electricity will be utilized by water pumping, wide spectrum growing lights, emergency air exhaust. (3) Wind and thermal powered air exhaust system. (4) Solar food dehydration. (5) Solar hot water production. (5) Auxiliary wood heat. (6) CO₂ heat, and fertilizer production by aerobic decomposition.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

558

PROJECT TITLE: Solar Greenhouse and Wood Home Heating Research and Demonstration Project (RAE 153)

INVESTIGATOR: Gary J. Franklin, 4428 6th Ave., South, Great Falls, MT 59405, (406) 761-0645)

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$5,000

DURATION: 7/77 - 7/78

LOCATION: MT - Cascade County (Great Falls)

DESCRIPTION: This project will construct a solar greenhouse on the south side of an existing home and also install a wood heater which will work in conjunction with the greenhouse in providing heat for both units. The combination of these two installations is expected to provide up to 98% of the space heating requirements of the home due to the ideal configuration of the house floor plan. The greenhouse will also provide an environment for the growing of food on a year round basis.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

559

PROJECT TITLE: 52°F Artesian-Heat Pump Heated Home and Greenhouse Demonstration Project (RAE 505)

INVESTIGATOR: Dave Harriman, Post Creek, St. Ignatius, MT 59865, (406) 745-3113

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$4,000

DURATION: 7/77 - 7/78

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LOCATION: MT - Lake County (St. Ignatius)

DESCRIPTION: This project will (1) Install a heat pump system using artesian water as the heat source; (2) Erect a year-round greenhouse using the artesian water in conjunction with solar energy. With the use of the artesian well water as the source of heat and air as the heat transfer medium, this heating/cooling system will run year-round. The large quantity of water available from the well and its disposal after passage through the heat pump system to existing fish ponds makes this project economically and physically practical.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

560

PROJECT TITLE: Solar Domestic Hot Water Preheating/Home Heating Wood Backup Heating (RAE 040)

INVESTIGATOR: John Alexander, Box 426, McLeod Route, Big Timber, MT 59011, (406) 932-3345

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$10,531

DURATION: 1/78 - 1/79

LOCATION: MT - Sweet Grass County (Big Timber)

DESCRIPTION: This project involves an active, solar air heating system in which the exposed southern roof area, 480 square feet, will be glazed with the entire attic serving as the solar collector. The heated air from the attic will be circulated to a rock storage area. A domestic hot water preheating tank will be located in the rock storage area. A Hippert wood furnace and two, high-efficiency fireplaces will also supply home heat.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

561

PROJECT TITLE: Wood Heated Underground Structure (RAE 064)

INVESTIGATOR: John Badgley, Institute of the Rockies, 622 Evans, Missoula, MT 59801, (406) 728-5352

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$3,675 DURATION: One year grant starting in early 1978.

LOCATION: MT - Missoula County (Missoula)

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Integrated Systems

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DESCRIPTION: This project will compile information that is currently available on the state-of-the-art of underground building. It will also study the feasibility of an underground, wood-heated conference center near Missoula. If this project appears to be feasible, a final design will be prepared. This project can make a contribution towards meeting future energy needs by showing: (1) The cost effectiveness of sub-terranean architecture; (2) The potential for energy savings in underground structures; (3) The potential for passive solar space heating in underground structures; (4) The potential for integrating the storage systems for two new renewable energy sources (passive solar and wood); and (5) The desirability of the environment created through sub-terranean architecture.

PUBLICATIONS: Quarterly and final reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

562

PROJECT TITLE: Solar Heated Carpenter Shop (RAE 065)

INVESTIGATOR: Phillip Schmitz, Rt 1, Box 40, Ronan, MT 59864, (406) 676-5069

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$4,649 DURATION: One year grant starting in early 1978

LOCATION: MT - Lake County (Ronan)

DESCRIPTION: This project will demonstrate a home-built, 480 square foot, air solar collector system with rock storage that will heat a carpenter shop. A wood burning stove will also be modified to allow its heat to be ducted into the storage area. The intent is to determine what percentage of the total heating demand will be provided by solar energy in a limited use situation typical of most all commercial and industrial buildings.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

563

PROJECT TITLE: Solar Heating and Domestic Hot Water/Photovoltaic/Wind Electric System (RAE 072)

INVESTIGATOR: AERO-West, 323 West Alder, Missoula, MT 59801, (406) 728-0015

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$6,498 DURATION: 2/78 - 2/79

LOCATION: MT - Missoula County (Missoula)

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DESCRIPTION: AERO-West wishes to retrofit the Horizon House and install various alternative energy devices so that the house will become a model for the public to visit, look at or do research and information gathering on alternative energy and energy conservation systems. This project will demonstrate a wind electric and photovoltaic, electrical system. It will also demonstrate an active, liquid, 300 square foot solar space heating system in which the collectors will be mounted on the ground adjacent to the building. Sixty square feet of additional collector area will be used for domestic hot water preheating. A portion of the fund will be used to purchase educational material for the renewable energy library that is housed in the building.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

RENEWABLE ENERGY SOURCES

3.8 OTHER

RENEWABLE ENERGY SOURCES/Other

564

PROJECT TITLE: New Western Energy Show (RAE 13, RAE 707)

INVESTIGATOR/ORGANIZATION: Kye Cochran, Alternative Energy Resources Organization, 435 Stapleton Building, Billings, MT, (406) 259-1958

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: 1976 - \$24,480; 1977 - \$44,800 (The New Western Energy Show is also supported by other public donations.)

DURATION: Summer 1976 and Summer 1977. This will be a continuing program.

LOCATION: MT - Statewide

DESCRIPTION: The New Western Energy Show brings a workshop-plus-information approach to communities around Montana, spending up to a week in each area. Activities include: (1) Building a solar water heater, and leaving it to be installed in a local building; (2) Displaying operational renewable energy equipment (wind generators, solar panels, a methane digester, small hydro systems); (3) Distributing relevant books and pamphlets on energy use and conservation; (4) Illustrating graphically the applications of bio-gas technology on homestead, feedlot, municipal sewage and other levels; (5) Demonstrating simple, low-cost energy-saving techniques; (6) Entertaining and informing audiences with country-folk-style music and theatrical presentations -- all with energy-related themes. By bringing the workshop/information dissemination format plus a program of educational/entertaining drama to rural towns in Montana, they expect to reach a large population which would otherwise have difficulty in obtaining information on renewable energy, and they hope to catalyze community efforts toward energy conservation and utilization of renewable energy sources.

PUBLICATIONS: Reports have been submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

565

PROJECT TITLE: Jocko Hollow Alternative Energy Effort (RAE 41)

INVESTIGATOR: Jim Anderson, Jocko Hollow Alternative Energy Effort, Arlee, MT, (406) 726-3336

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$20,000

DURATION: 11/76 - 11/77

LOCATION: MT - Lake County (Arlee)

DESCRIPTION: This project will: (1) Establish a center to act as a resource center and clearinghouse for alternative energy interests in western Montana; (2) Construct physical working models designed to demonstrate alternative energy practicality and reliability; (3) Conduct investigations on the

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existing state of the art; and (4) Develop a framework for future projects.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

566

PROJECT TITLE: Center for Innovation (RAE 82)

INVESTIGATOR/ORGANIZATION: Clyde LaGrone, Division Manager, Center for Innovation, P.O. Box 3809, Butte, MT 59701, (406) 494-4569

FUNDING AGENCIES: State of Montana (Energy Planning Div., Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program); Old West Regional Commission; U.S. Department of Commerce, Economic Development Administration

FUNDING AMOUNT: FY 78 - \$100,000 (State of Montana); \$400,000 (OWRC); \$300,000 (U.S. Dept. of Commerce)

DURATION: 1977 - Continuing

LOCATION: MT, ND, SD, WY, NE

DESCRIPTION: The Center for Innovation (a division of the Montana Energy and MHD Research and Development Institute) is responsible for assisting the inventor/entrepreneur with any and all phases of the innovation process -- from conception to marketing -- to ensure the highest quality outcome for the smallest investment of funds and resources. One of the most important functions of the Center for Innovation is helping the small businessman and/or inventor secure federal, state, or private funds and other forms of institutional support for specific projects that show technical promise and economic development potential. Furthermore, the Center for Innovation expects to supply the essential services directly to the inventor within his or her own community. The CFI will promote the development and introduction of alternative technology. The purpose of the Center will be to generate projects which translate into small business applications that produce and market newly developed technology utilizing renewable energy resources.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601, as well as to the other funding agencies.

567

PROJECT TITLE: An Experimental Heat Control and Energy Monitoring System (RAE 180)

INVESTIGATOR: Donald K. Weaver, Jr., 1820 South 7th Ave., Bozeman, MT 59715

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$6,000

DURATION: 7/77 - 7/78

LOCATION: MT - Gallatin County (Bozeman)

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DESCRIPTION: This project will assemble a low-cost data acquisition system and use it to monitor and control all energy-related parts of the operation of an existing residence. This will include continuous monitoring and recording of gas and electricity, temperature both outside and at various inside locations, wind and solar radiation. The project will also attempt to reduce peak energy demands by closing off parts of the house and using a wood burning stove or other supplemental heat to help carry part of the load. This program will develop the necessary instrumentation and control to make computer control of energy use economical even in relatively small buildings.

PUBLICATIONS: Quarterly and final reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

568

PROJECT TITLE: A Project to Develop an Energy Use and Design Course for Building Contractors (RAE 182)

INVESTIGATORS: John A. Charles and Robert O. Warrington, Mechanical Engineering Dept., Montana State University, Bozeman, MT 59715, (406) 994-2203

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$21,000

DURATION: 7/77 - 7/78

LOCATION: MT - Gallatin County (Bozeman), and statewide

DESCRIPTION: It is the purpose of this project to develop and conduct a short course for building contractors and others to familiarize them with the theory of energy usage and present changes in building design/construction which would lead to the construction of more energy-efficient buildings suited for use with both conventional and alternate energy sources. The course would be taught by Mechanical Engineering faculty members at Montana State University as both a night course at Montana State University, and a correspondence course for persons removed from the Bozeman area. The course would have three primary goals: (1) To introduce builders to the engineering theory of energy, including its generation, usage, and concepts of efficiency; (2) To encourage a critical evaluation of current building practices as they affect energy usage; and (3) to investigate the possibility for improving the energy efficiency of buildings.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

569

PROJECT TITLE: Development of an Alternative Energy Testing Laboratory (RAE 113)

INVESTIGATOR/ORGANIZATION: Thomas Reihman, Dept. of Mechanical Engineering, Montana State University, Bozeman, MT 59715, (406) 994-2203

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

RENEWABLE ENERGY SOURCES/Other

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FUNDING AMOUNT: \$12,000

DURATION: One year grant starting in early 1978

LOCATION: MT - Gallatin County (Bozeman)

DESCRIPTION: The Mechanical Engineering Department wishes to establish an Energy Testing Laboratory that would test and evaluate available renewable energy equipment for use in Montana. Of primary importance would be the distribution of the information obtained from the Energy Testing Laboratory. Equipment would be transported to Montana State University where it would be tested. The ultimate goal of this program is the development of information useful to the people of Montana in deciding whether a particular alternate energy system is practical and in deciding which component works best in Montana.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Montana Dept. of Natural Resources and Conservation, Helena, MT 59601.

570

PROJECT TITLE: Legal and Institutional Study to Promote Development of Renewable Energy (RAE 702)

INVESTIGATOR: Richard Klinger, 619 First Street, Helena, MT 59601

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$10,000

DURATION: One year grant starting in early 1978

LOCATION: MT - Statewide

DESCRIPTION: The purpose of the project is to conduct a comprehensive study of existing and potential legal and institutional mechanisms which would stimulate the development and use of renewable energy. The study would include a review, inventory and analysis of existing laws, regulations, ordinances and incentive programs that bear upon aspects of encouraging the development and/or use of renewable energy sources. In addition, the study will include recommended modifications and/or additions to existing laws, regulations, ordinances and incentive programs, and will recommend other legislation which might facilitate increased research, demonstration and utilization of renewable energy resources.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

571

PROJECT TITLE: A Year-Round Renewable Energy Demonstration Center for the New Western Energy Show (RAE 704)

INVESTIGATOR/ORGANIZATION: c/o Kye Cochran, Alternative Energy Resources Organization, 435 Stapleton Building, Billings, MT 59101, (406) 259-1958

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program); The Center will also be supported by other public donations.

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FUNDING AMOUNT: \$24,800

DURATION: 2/78 - 2/79

LOCATION: MT - Lewis and Clark County (Helena)

DESCRIPTION: This project will establish a year-round renewable energy demonstration center for the New Western Energy Show. (See Project No. 564.) A few of the major goals that this center hopes to accomplish are: (1) Maintain and update the New Western Energy Show's exhibits, devices and informational displays; (2) Conduct practical, hands-on workshops in the various areas of renewable energy; (3) Organize conferences for various energy organizations concerning energy conservation, renewable energy, and appropriate technology; (4) Continue to develop and present lectures, slide shows, films and video tapes relating to energy for the general public; (5) Develop energy educational programs for elementary and secondary schools, colleges, universities, senior citizens associations, public service organizations and professional organizations.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

572

PROJECT TITLE: Energy/Environment Simulator Demonstration Project (RAE 708)

INVESTIGATOR/ORGANIZATION: Ed Eschler, Montana Office of Public Instruction, Capitol Building, Helena, MT 59601, (406) 449-2543

FUNDING AGENCY: State of Montana (Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Alternative Renewable Energy Sources Program)

FUNDING AMOUNT: \$3,000

DURATION: 1/78 - 1/79

LOCATION: MT - Statewide

DESCRIPTION: This project will purchase and make available an "Energy/Environment Simulator" to local schools on a week long basis so that students may become aware of the need to conserve energy and the need to develop renewable alternative energy sources. The energy/environment simulator presents the interrelationship between energy sources, their supply, their demand, their limit, and the environmental repercussions of their use. The device is a simple analog computer by which each participant controls a resource and its use, trying at all times to meet the lifestyle demanded by the population under the restraint of environmental compatibility on a pre-set time scale.

PUBLICATIONS: Quarterly and Final Reports will be submitted to the Energy Planning Div., Mt. Dept. of Natural Resources and Conservation, Helena, MT 59601.

RENEWABLE ENERGY SOURCES/Other

573

PROJECT TITLE: Montana Renewable Energy Project

INVESTIGATORS/ORGANIZATIONS: Kye Cochran, Alternative Energy Resources Organization, 435 Stapleton Building, Billings, MT 59101, (406) 259-1958; Jim Nybo, Montana Energy Advisory Council, Capitol Station, Helena, MT 59601, (406) 449-3940.

FUNDING AGENCY: State of Montana - Montana Energy Advisory Council (now the Montana Energy Office)

FUNDING AMOUNT: Approx. \$2,500

DURATION: 3/76 - 1/77 (Completed)

LOCATION: MT - Statewide

DESCRIPTION: The purpose of this project was to prepare a very basic guide to renewable energy resources in Montana. Information was collected on energy conservation practices, solar energy, wind power, biogas, wood, water, and architecture and design. A list of references on each of these topics was compiled.

PUBLICATIONS: Kye Cochran. Montana Renewable Energy Handbook. March 1977. Available from the Montana Energy Office, Capitol Station, Helena, MT 59601.

574

PROJECT TITLE: Montana Solar Planning Effort

INVESTIGATOR/ORGANIZATION: Randall Moy, Montana Energy Office, Capitol Station, Helena, MT 59601, (406) 449-3940

FUNDING AGENCY: U.S. Department of Energy (through Solar Planning Office-West)

FUNDING AMOUNT: \$17,700 (9/77 - 3/78)

DURATION: 9/77 - Continuing

LOCATION: MT - Statewide

DESCRIPTION: Goal - To determine the manner in which Montana and the other states of the western region can most effectively foster immediate and rapid development of renewable energies (wind, solar, water, etc.). Objective - Identify and integrate various entities that are or should be involved with solar energy development into a viable solar infrastructure within Montana that can implement programs or elements of programs, formulated and recommended by the Montana Solar Planning Effort, which in turn will realize certain levels of solar development in Montana and the states of the western region by the year 1983. Work Plan - (1) Solar Resource Inventories: Inventories of solar resources will be collected for Montana; (2) Problem Identification: Problems that would impede development of a viable solar industry and market in Montana will be identified by questionnaires, mini-energy hearings, specialized workshops, and a thorough literature search; (3) Problem Analysis: All information from 1 and 2 above will be analyzed and formulated into problem statements; (4) Program Recommendation: Programs recommended to hasten solar development within the western region, subregional areas and Montana will include an implementation scheme for the entire Western region that can not only carry out programs recommended but will allow access to the solar infrastructures found in each state; (5) Reporting: The results of the Solar Planning Effort will be published in a report to the Solar Planning Office-West. A Solar Directory will also be published.

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PUBLICATIONS: Montana Solar Plan (Draft due December 1, 1977; Final due March 1, 1978). A Solar Directory will also be published.

575

PROJECT TITLE: Montana Alternative Renewable Energy Sources Program

INVESTIGATOR/ORGANIZATION: Gerhard Knudsen, Program Manager, Alternative Renewable Energy Sources Program, Energy Planning Division, Mt. Dept. of Natural Resources and Conservation, 32 South Ewing, Helena, MT 59601, (406) 449-3780

FUNDING AGENCY: State of Montana (authorized in 1975 by Senate Bill 86)

FUNDING AMOUNT: Yearly funding of the program is derived from 2½ percent of 75 percent of the state coal severance tax through 1979; thereafter, the amount available will be 5 percent of 50 percent. In the first funding period of 1976 approximately \$490,000 was granted; in the first funding period of 1977 approximately \$540,000 was granted; and in the second funding period of 1977 approximately \$370,000 was granted.

DURATION: This will be an ongoing program. Grants are given for a period of one year.

LOCATION: Montana - Statewide

DESCRIPTION: The Montana Alternative Renewable Energy Sources Program was authorized in 1975 by Senate Bill 86. Under the program, administered by the Energy Planning Division of the Montana Dept. of Natural Resources and Conservation, grants are awarded for non-commercial projects which research, develop, and demonstrate the use of renewable energy sources such as solar, wind, geothermal, and biomass. All resident Montana individuals and organizations are eligible to apply for grants.

PUBLICATIONS: Each project which is funded by the Alternative Renewable Energy Sources Program will submit quarterly and final reports to the Energy Planning Division of the Montana Department of Natural Resources and Conservation. All information resulting from the projects is made available to the public.

576

PROJECT TITLE: Renewable Energy Demonstration Project (Task of C-77-02)

INVESTIGATORS/ORGANIZATION: Susan Brown, J. Andrew Kissner, Montana Trade Commission, P.O. Box 767, Butte, MT 59701, (406) 723-3228; The Montana Energy and MHD Research and Development Institute is also participating in the project.

FUNDING AGENCY: U.S. Department of Commerce, Economic Development Administration

FUNDING AMOUNT: Part of Project No. 620 DURATION: 7/77 - 6/78

LOCATION: MT - Valley County (Valley Industrial Park)

RENEWABLE ENERGY SOURCES/Other

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DESCRIPTION: There are currently numerous private, state and federal agencies involved in answering research questions concerning renewable energy technologies such as solar, wind and lowhead hydro. Due to the marginal economic competitiveness of these technologies, many of the technological questions which have been answered in lab testing have not been highly demonstrated in field applications. Consequently, this project is directed at promoting infield renewable energy development through identifying existing facilities at Glasgow Air Force Base which would lend themselves to demonstrating one or more renewable technologies as well as exploring opportunities for manufacturing solar, wind and lowhead hydro components. (NOTE: This is a sub-task of "Evaluation and Implementation of Redevelopment Alternatives for Valley Industrial Park, Montana, Project No.620 .)

PUBLICATIONS: Progress reports to U.S. Dept. of Commerce, Economic Development Administration.

577

PROJECT TITLE: Western Regional Solar Plan

INVESTIGATOR/ORGANIZATION: Ray Gilbert, Director, Solar Planning Office-West, Suite 2500, 3333 Quebec Street, Denver, CO 80210

FUNDING AGENCY: U.S. Department of Energy, Division of Solar Energy

FUNDING AMOUNT: \$697,000

DURATION: 7/77 - 3/78

LOCATION: MT, WA, WY, OR, CA, NV, AZ, CO, NM, UT, AK, HI, ID (Solar Planning Office-West is located in Denver, CO)

DESCRIPTION: The basic objective of the Western Regional Planning Effort has been to define programs for the stimulation of broader and earlier use of solar energy. Emphasis is on the needs of end-use consumers of solar energy. The approach has been to distribute the work load to the states. The Solar Planning Office-West (SPOW) has issued grants to the individual states to: 1) Identify the solar energy resources, capabilities and needs and give the status of solar energy activities within the state; 2) Determine an initial set of state priorities, together with supporting rationale, for activities to encourage solar energy applications; 3) Identify and discuss the existing and anticipated deterrents to and desirable incentives for expanding the use of solar energy; and 4) Recommend programs, together with rationales, cost, schedules, and expected results, to reduce or eliminate deterrents and to implement incentives. The Solar Planning Office-West will then synthesize the information provided by the states and thereby develop a plan with projects and proposals designed to accelerate the development of solar energy in the west.

PUBLICATIONS: A two-volume report will be available March 31, 1978 from each State Energy Office, SPOW Office, and DOE. Volume I: Western Regional Solar Plan; Volume II: Individual State reports.

ENERGY UTILIZATION

4.1 CONSERVATION

ENERGY UTILIZATION/Conservation

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PROJECT TITLE: Development of Contingency Plans for Carpooling in the Billings, Great Falls, and Helena Urban Areas

INVESTIGATORS/ORGANIZATIONS: For Billings - Norman K. Gutcher, Billings-Yellowstone City-County Planning Board, Billings, MT (406) 248-5711; For Great Falls - John Richards, Great Falls City County Planning Board, Great Falls, MT (406) 727-5881; For Helena - Gary Funkhauser, Engineering Dept., City of Helena, Helena, MT 59601 (406) 442-9920

FUNDING AGENCY: U.S. Department of Transportation (Federal funds for this program are authorized by the Emergency Highway Energy Conservation Act approved by Congress on December 21, 1973)

FUNDING AMOUNT: Each city received \$1,800 of federal funds and about \$200 of State funds.

DURATION: Billings - 1/75 - 4/75 (Completed); Great Falls - 1/76 - 3/76 (Completed); Helena - 1/76 - 5/76 (Completed)

LOCATION: MT - Yellowstone Co. (Billings); Cascade Co. (Great Falls); Lewis and Clark Co. (Helena)

DESCRIPTION: These projects were designed to develop contingency plans for carpooling programs in the Billings, Great Falls, and Helena urban areas. The objectives of the carpooling program are to encourage the use of carpools and public transit in these areas, and thus, increase the average automobile occupancy during the peak traffic, or "rush" hours. With fewer vehicles there will be less vehicle miles of travel and, consequently a savings of fuel. The carpooling program will have three phases: (1) The preparation phase where public information material and a computer matching program will be developed; (2) The implementation phase when local area employees will be informed of the proposed program, travel desire data developed, and the Montana Department of Highway computer used in the matching process and storage of data; and (3) The surveillance and evaluation phase when the effectiveness of the program will be measured in terms of the number of carpools formed and by vehicle occupancy rate checks. These plans will be implemented only if and when a future emergency or fuel shortage happens.

579

PROJECT TITLE: Development and Implementation of an Energy Conservation Survey for the State of Montana

INVESTIGATOR/ORGANIZATION: Jenny Younger, League of Women Voters, Route 3, Box 155A, Bozeman, MT 59715, (406) 587-2300

FUNDING AGENCY: U.S. Federal Energy Administration (through State Energy Conservation Plan funds administered by the Montana Energy Office)

FUNDING AMOUNT: Up to \$2,000

DURATION: 10/77 - 12/77 (Completed)

LOCATION: MT - Statewide

ENERGY UTILIZATION/Conservation

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DESCRIPTION: The League of Women Voters is assisting with the development and implementation of an energy conservation survey for the state of Montana. The intent of the survey is to: (1) Determine the extent of public attitude relating to the need for energy conservation; and (2) Determine the extent of public knowledge of how to conserve energy.

PUBLICATIONS: The Montana Energy Office will receive completed survey forms. The results will be analyzed and made available to the public. Contact the Montana Energy Office, Capitol Station, Helena, MT 59601 for more information.

580

PROJECT TITLE: Development of Sod-Seeding Methods for Establishment of Small Seeded Grasses and Legumes

INVESTIGATOR/ORGANIZATION: Leon Welty, Montana Agricultural Experiment Station, Northwestern Agricultural Research Center, 1570 Montana 35, Kalispell, MT 59901, (406) 755-4303

FUNDING AGENCY: Old West Regional Commission; Agricultural Experiment Station

FUNDING AMOUNT: \$95,512 (Old West); \$12,200 (MAES) DURATION: 4/77 - 6/79

LOCATION: MT

DESCRIPTION: Objectives - (1) Test various forage minimum-till drills that are currently available in industry and at State Experiment Stations; (2) Determine the correct cultural and management practices for establishment of small-seeded legumes and grasses into pasture, range and hay land; (3) Initiate research for an economic analysis of minimum-tillage vs. conventional-tillage establishment; (4) Establish demonstrations to enable the farmer-rancher to see the principles of minimum-till forage establishment. An important part of this effort will be energy costs of various methods of renovating the various grassland types.

581

PROJECT DESCRIPTION: Energy Conservation Program for State Buildings in Montana

INVESTIGATOR/ORGANIZATION: Alex Drapes, Drapes Engineering, 202 Eklund Bldg., Great Falls, MT 59401, (406) 452-9558

FUNDING AGENCY: State of Montana (Dept. of Administration) - Funded by HB 144, 45th Legislature

FUNDING AMOUNT: \$200,000 LOCATION: MT DURATION: 11/77 - 11/78

DESCRIPTION: Goal - To reduce energy consumption in, and life cycle costs of, existing state-owned buildings. Program - (1) Gather energy consumption data; (2) Establish priorities and program cash flow; (3) Conduct energy audit of metered buildings and select buildings to be surveyed on a life cycle analysis; (4) Conduct life cycle cost analysis of buildings selected to be surveyed; (5) Submit capital project request to legislature for retrofit construction and continuation of meter installation, and life cycle cost surveys; (6) Monitor results of energy conservation program.

582

PROJECT TITLE: Four Wheel Drive Tractor Utilization

INVESTIGATOR/ORGANIZATION: W.E. Larsen, Dept. of Agricultural Engineering, Montana State University, Bozeman, MT 59601; also 50 or more farmer cooperators in Montana

FUNDING AGENCY: International Harvester Co. FUNDING AMOUNT: \$10,000

DURATION: 12/76 - continuing LOCATION: MT - Statewide

DESCRIPTION: To determine how four wheel drive tractors are actually being used under Montana conditions and to obtain energy measurements on four-wheel drive operations that will permit machinery decisions on an energy efficiency basis.

PUBLICATIONS: A thesis will be written. Anticipated publication, January 1979.

583

PROJECT TITLE: Local Government Energy Conservation and Energy Media Project

INVESTIGATORS/ORGANIZATION: Dan K. Mizner, Jim Lubek, Earl Haakensen, Montana League of Cities and Towns, P.O. Box 1704, Helena, MT 59601, (406) 442-8768

FUNDING AGENCY: Department of Labor, Comprehensive Employment and Training Act; also in kind support from the Montana Department of Community Affairs and the League of Cities and Towns

FUNDING AMOUNT: \$23,746 (CETA); \$12,000 (In kind DCA & League)

DURATION: 7/77 - 9/78 LOCATION: MT - Statewide

DESCRIPTION: Objectives - To provide local government with training materials to implement and operate energy conservation management efforts in cooperation with State energy policy. To produce multi-media material for use of local government program.

PUBLICATIONS: Five slide shows describing various aspects of energy management programs for local governments have been developed. Available from all of the State's Human Resources Development Councils or from the League of Cities & Towns.

584

PROJECT TITLE: Method of Grain Production Comparing Minimum Tillage, No Tillage, Chemical Fallow and Tillage Fallow

INVESTIGATOR/ORGANIZATION: Arthur L. Dubbs, Montana Agricultural Experiment Station, Central Agricultural Research Center, Montana State University, Moccasin, MT 59462, (406) 423-5227

FUNDING AGENCIES: Montana Agricultural Experiment Station; Montana Wheat Research and Marketing Committee

ENERGY UTILIZATION/Conservation

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FUNDING AMOUNT: FY77 - \$1,500 (MAES); \$500. (Wheat Research & Marketing Comm.)

DURATION: 1/75 - 1/83

LOCATION: MT

DESCRIPTION: Minimum tillage, no tillage, and chemical fallow are all methods of farming related to the conservation of energy, mainly petroleum products. Farm tractors are heavy users of fuel and if methods of crop production can be worked out where tillage practices are reduced, considerable fuel can be saved. Fuel savings will be determined each year.

PUBLICATIONS: Considerable research is being conducted in the mid-West on no tillage and minimum tillage. Results will be published annually in the State Soils Report.

585

PROJECT TITLE: Montana Energy Conservation Program

INVESTIGATOR/ORGANIZATION: Jerry Toner, Montana Energy Office, Capitol Station, Helena, MT 59601, (406) 449-3940

FUNDING AGENCY: U.S. Federal Energy Administration

FUNDING AMOUNT: \$53,100 (Planning funds 10/76 - 6/77); \$159,000 - FY 77, \$331,300 - FY 78 (Basic Program); \$86,000 - FY 77, \$167,800 - FY 78 (Supplemental Program)

DURATION: 10/76 - Continuing

LOCATION: MT - Statewide

DESCRIPTION: The 1975 Energy Policy and Conservation Act (P.L. 94-163) designated funds for states to develop comprehensive energy conservation plans. The Federal Energy Administration (now Department of Energy) is coordinating the development of these plans in every state. In Montana, the state's Energy Office has been given the lead responsibility for developing Montana's plan. The Montana Energy Conservation Plan has two basic goals: (1) To satisfy the requirement for a 5 percent reduction in energy consumption by December 31, 1980; and (2) To satisfy the requirement for long-range energy conservation strategies. The basic energy conservation program measures for 1978 are: (1) Statewide Building Code and Thermal Efficiency Standards; (2) Lighting Standards for Public Buildings; (3) Procurement - Life Cycle Cost Analysis and Vehicle Fuel Efficiency Standards; (3a) Energy Managing, Auditing, and Retrofitting State Buildings; (3b) Renewable Energy Demonstration Project; (4) Right Turn on Red; (5) Car Pool/Van Pool: Increase in Transit Level of Service; (5b) Bike-way Construction; (5c) Enforcement of 55 MPH Speed Limit; (6) Weatherization; (8) Renewable Energy Tax Credit; (9) Public Utility Measures; (10) Energy Conservation Education; (10a) Public Education - Energy Audit; (11) Energy Audit; (12) Program Administration - Coordination; (13) Energy Conservation Data Base

PUBLICATIONS: (1) Interim Report Summary -- The Montana Energy Conservation Plan, November 1976; (2) The Montana Energy Conservation Plan, March 1977. Revised June 1977 and January 1978. Available from the Montana Energy Office.

586

PROJECT TITLE: Montana Weatherization Program

INVESTIGATOR/ORGANIZATION: Jim Nolan, Human Resources Division, Mt. Dept. of Community Affairs, Helena, MT 59601, (406) 449-3420

FUNDING AGENCIES: U.S. Community Services Administration; Old West Regional Commission; State of Montana (HB 701, 1977 Leg.); U.S. Federal Energy Administration

DURATION: 9/75 - Continuing

LOCATION: MT - Statewide

DESCRIPTION: The Emergency Energy Conservation Program is Section 222 (A) (12) of the Community Services Act of 1974. Administered by the CSA, the program is intended to enable low income individuals and families, including the elderly and near poor, to lessen the impact of high energy costs. The Human Resources Division of the Mt. Dept. of Community Affairs funds seven local Human Resources Development Councils that serve all 12 of the state's planning districts, to "winterize," i.e. perform energy home repairs and energy savings activities for the target groups. Since the weatherization program started in 1975, about 2,800 homes have been weatherized. It has been estimated that, on the average, a 22 percent energy-use reduction has resulted.

587

PROJECT TITLE: Regional Evaluation of Off-Season Agricultural Use of Water and Energy Resources (B-052-SKAK)

INVESTIGATORS/ORGANIZATIONS: L.B. Stone, South Dakota State University; M.L. Horton, South Dakota State University, T.L. Hanson, Montana State University

FUNDING AGENCY: U.S. Department of the Interior, Office of Water Research and Technology

FUNDING AMOUNT: \$24,168

DURATION: 10/76 - 9/77

LOCATION: MT (Bozeman); KS (Tribune); SD (Redfield)

DESCRIPTION: Objective - Evaluate fall and early spring irrigations as related to: (1) Reducing the peak summer load requirements of water and energy; (2) Water use efficiency and crop production; (3) Soil temperature and subsequent effects upon crop production; and (4) Irrigation system-size and energy requirements. Approach - Irrigation timing field research plots will be located near Tribune, Kansas (corn and winter wheat); Redfield, South Dakota (alfalfa, corn, and spring wheat); and Bozeman, Montana (alfalfa and spring wheat). Combinations of fall, spring and in-season irrigations will be employed. Water applied will be 50% of the available water capacity for a soil not to exceed the field capacity. Profile soil water contents will be taken immediately before and after each irrigation as well as monthly during the 'off-season.' Soil temperature at the 5 and 20 cm soil depths will be measured. Grain yield and dry matter production will be determined and used in calculating water use efficiency and agronomic performance of the irrigation schedules. Daily max-min air temperature, precipitation, daily humidity, and evaporation from a standard pan will be measured. Modeling techniques will be applied to the field data to evaluate the benefits and costs of extended season irrigation.

ENERGY UTILIZATION

4.2 DEMAND AND CONSUMPTION

4.3 OTHER (INCLUDING TRANSMISSION)

ENERGY UTILIZATION/Demand and
Consumption

588

PROJECT TITLE: Alternative Scenario: Electrical Energy Future for the Pacific Northwest

INVESTIGATORS/ORGANIZATION: Roger Beers, Terry Lash, Natural Resources Defense Council, Inc., 2345 Yale Street, Palo Alto, CA 94306, (415) 327-1080

FUNDING AGENCIES: Natural Resources Defense Council; U.S. Energy Research and Development Administration; Sierra Club Foundation; Oregon Environmental Foundation; Northwest Fund for the Environment

FUNDING AMOUNT: \$17,000 (ERDA); Approx. \$30,000 (NRDC)

DURATION: 6/76 - 2/78

LOCATION: Pacific Northwest; Assumption is that the Northern Great Plains would provide some of the coal for the Pacific Northwest's energy requirements.

DESCRIPTION: The purpose of this study is to stimulate further dialogue and planning concerning the Pacific Northwest's future needs for electrical energy and the optimum means of meeting those needs. Until recently, almost 90 percent of the region's electricity was provided from hydroelectric facilities. With the decline in the potential for additional hydroelectric generation, the region's utilities, the Bonneville Power Administration (BPA) and its industrial customers have developed plans which call for greatly increased reliance on large thermal power plants for the region. More recently, others have argued that these plans seriously overstate the need for additional generation of electricity and that substantial savings could be achieved by encouraging more efficient use of electricity, while investigating alternative, cleaner energy technologies. This study attempts to investigate alternative energy scenarios for the Pacific Northwest.

PUBLICATIONS: Roger Beers and Terry Lash. Choosing an Electrical Energy Future for the Pacific Northwest: An Alternate Scenario -- Final Draft. January 31, 1977. Available from the Natural Resources Defense Council.

589

PROJECT TITLE: Electrical System Load Survey -- Residential Class

INVESTIGATOR/ORGANIZATION: Stephen Winter, The Montana Power Company, 40 East Broadway, Butte, MT 59701; Paul Polzin, Bureau of Business and Economic Research, University of Montana, Missoula, MT 59801, has been retained as a consultant for this project.

FUNDING AGENCIES: Montana Power Company; Montana Consumer Counsel(State of Montana)

FUNDING AMOUNT: \$271,250 (MPC); \$42,350 (Consumer Counsel)

DURATION: 6/76 - 8/79

LOCATION: MT - Statewide

ENERGY UTILIZATION/Demand and
Consumption

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DESCRIPTION: The objective is to secure 15-minute electrical demand data for a statistically-valid sample of Montana Power residential customers over a two year operating period. This data collection requires installation and service of approximately 200 recording meter installations. The subsequent analysis of the data is expected to produce input to cost of service studies for the utility.

PUBLICATIONS: Electric Utilities Demonstration Project Proposal. By the Montana Public Service Commission to the U.S. Federal Energy Administration. In addition, a report has been submitted by MPC to the Legislature's Consumer Council Committee.

590

PROJECT TITLE: Projections of Energy Consumption in Montana to 1990

INVESTIGATOR/ORGANIZATION: Eric Anderson, Mountain West Research, Inc., 1739 Grand Avenue, Billings, MT 59102

FUNDING AGENCY: Old West Regional Commission

DURATION: 8/76 (Completed)

LOCATION: MT - Statewide

DESCRIPTION: Recognizing the importance of analyzing and understanding Montana's energy requirements, the Montana Energy Advisory Council initiated a program to assemble this information. The purpose of this work was to present initial energy consumption projections for Montana. The primary data source for most of the energy and fuels data was the U.S. Bureau of Mines. Other sources included the Montana Public Service Commission, the Federal Power Commission, and the two principal utilities in Montana. The principal projection hypothesis was that the level of consumption of a particular energy fuel is determined by the number of consumers, the temperature during the year, the price per unit of the fuel, and the price per unit of competing energy sources.

PUBLICATIONS: Energy Consumption in Montana: Projections to 1990. August 1976.

591

PROJECT TITLE: Study of Future Electricity Prices in Montana

INVESTIGATOR/ORGANIZATION: John W. Duffield, Department of Economics, University of Montana, Missoula, MT (406) 243-4646

FUNDING AGENCY: State of Montana (Dept. of Administration and Office of Budget and Program Planning) - Montana Energy Advisory Council, Project Monitor

FUNDING AMOUNT: \$2,695

DURATION: 11/76 - 1/77 (Completed)

DESCRIPTION: This study was designed to provide a projection of the average prices of electricity for the western part of Montana. The purpose of the analysis is to provide decisionmakers in government and industry with a reliable forecast of future prices. The study is also concerned with identifying the effect

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on rates of changes in specific factors, such as fuel prices. It is anticipated that the results will be used for life-cycle costing in design and planning of future state building and heating systems.

PUBLICATIONS: John W. Duffield. The Future Prices of Electricity in Montana. January 1977. Prepared for the Mt. Dept. of Administration and MEAC. Available from the Montana Energy Office, Capitol Station, Helena, MT 59601.

592

PROJECT TITLE: A Montana Energy Model

INVESTIGATOR/ORGANIZATION: Byron Jones, Task Leader, Montana Energy and MHD Research and Development Institute, P.O. Box 3809, Butte, MT 59701, (406) 494-6100

FUNDING AGENCY: Old West Regional Commission

FUNDING AMOUNT: Approx. \$100-150K. This project is part of "An Energy-Related Feasibility Study and EIS for Reuse of Glasgow Air Force Base in Valley County, Montana," which is funded at \$1.1M. Funds for the EIS were transferred to the Commission by the U.S. Department of Defense which is charged with responsibility for maintaining the former air force base.

DURATION: 4/77 - 7/78

LOCATION: MT - Statewide

DESCRIPTION: A complete, dynamic energy-economic computer model of Montana will be developed which will be used to assess Montana energy supply and demand through the year 2000. Conventional energy forms, alternative energy sources, and energy supplies will be modeled. From these, a number of forecasts will be developed to give a prediction of the needs of Montana's primary, secondary, governmental, and household sectors. Also energy effects and capital constraints will be included which describe how changing energy policies and prices affect these sectors.

PUBLICATIONS: Quarterly report for October-December 1977 to the Old West Regional Commission, 228 Hedden-Empire Building, Billings, MT 59101.

593

PROJECT TITLE: Crisis Intervention Program

INVESTIGATORS/ORGANIZATION: Bryant Hatch, Steve Meloy, Human Resources Div., Mt. Dept. of Community Affairs, 1424 Ninth Ave., Helena, MT 59601, (406) 449-3420

FUNDING AGENCY: U.S. Community Services Administration

FUNDING AMOUNT: \$1,480,000 (Money left over after payment of utility bills will be used for a DCA administered home weatherization program for low-income residents. Carry over was \$1,247,033.)

DURATION: 8/77 - 9/77 (Completed)

LOCATION: MT

ENERGY UTILIZATION/Demand and
Consumption

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DESCRIPTION: The U.S. Congress appropriated \$200 million to the Community Services Administration for the Special Crisis Intervention Program which involves direct payments to utilities on behalf of eligible low-income persons. The purpose of the program is to relieve part of the energy-cost burden on low-income citizens because of last winter's weather conditions and rising energy costs. Montana's \$1,480,000 share of the program was determined by a congressional allocation formula. The Human Resources Division of the Mt. Dept. of Community Affairs was designated as Montana's program operator for the funds. Montana's allocation will be reallocated to 12 planning districts and seven Indian reservations. The administering agency in each district will be local Human Resources Councils; and on each reservation, the agency will be the Bureau of Indian Affairs Social Service Program. Money left over after payment of utility bills will be used for home weatherization aid for low income persons.

PUBLICATIONS: Montana's Plan for the Crisis Intervention Program. Available from the Human Resources Division, Dept. of Community Affairs, Helena, MT 59601.

594

PROJECT TITLE: Anaconda-Hamilton 161 Kilovolt Transmission Line Study --
Environmental Impact Statement

INVESTIGATOR/ORGANIZATION: Albert Tsao, Energy Planning Division, Montana
Dept. of Natural Resources and Conservation, 32 South Ewing, Helena, MT 59601
(406) 449-3780

FUNDING AGENCY: Montana Power Company (application fee)

FUNDING AMOUNT: \$47,625 DURATION: 12/74 - 9/76 (Completed)

LOCATION: MT - Deer Lodge, Granite, and Ravalli Counties (Anaconda to Hamilton)
Also Deer Lodge and Bitterroot National Forests

DESCRIPTION: In accordance with the Montana Utility Siting Act, an application was submitted by the Montana Power Company to the Department of Natural Resources and Conservation on December 31, 1974, for permission to construct 65 miles of a 161 kilovolt electric transmission line facility between Anaconda and Hamilton. The EIS which was prepared addresses the subjects of methodology used in preparation of the statement, discussions of electrical need for the line, system alternatives should the line be built, engineering design specifications, environmental concerns and impacts (aquatic ecosystems, land productivity, visual concerns, land use, terrestrial fauna, and socio-economic concerns), and an evaluation of alternative corridors, including brief discussions on short-term and long-term effects on productivity and irreversible and irretrievable effects.

PUBLICATIONS: Draft EIS, July 1976. Final EIS issued September 1976. Available from the Montana State Library, Helena, MT 59601.

595

PROJECT TITLE: Clyde Park - Dillon 161 Kilovolt and 69 Kilovolt Transmission
Lines -- Environmental Impact Statement

INVESTIGATOR/ORGANIZATION: Albert Tsao, Energy Planning Division, Montana
Dept. of Natural Resources and Conservation, Helena, MT 59601, (406) 449-3780

FUNDING AGENCY: Montana Power Company (application fee)

FUNDING AMOUNT: \$94,700 DURATION: 6/74 - 4/76 (Completed)

LOCATION: MT - Clyde Park to Dillon

DESCRIPTION: In accordance with the Montana Utility Siting Act, an application was submitted by Montana Power Company with the Dept. of Natural Resources and Conservation on June 6, 1974, for permission to construct an electric transmission line facility between Clyde Park and Dillon. This application was amended on June 30, 1975, to add a segment of 69 kilovolt transmission line. This EIS consists of an introduction, a description of methodology used, a need evaluation, a discussion of system alternatives, engineering design specifications, inventories and potential impact evaluation of environmental components of the study area, site-specific impact evaluations, and long-term considerations.

PUBLICATIONS: A draft EIS was issued in January 1976. The final EIS was issued in April 1976. It is available from the Montana State Library, Helena, MT 59601.

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PROJECT TITLE: Citizen's Advisory Committee on Energy (CACE)

INVESTIGATOR/ORGANIZATION: Gene Mahoney, Chairman, Citizen's Advisory Committee on Energy, c/o Governor's Office, State of Montana, Helena, MT 59601

FUNDING AGENCY: The Governor's Office sponsors CACE -- no funding to date. The Montana Energy Office and the Montana Environmental Quality Council have provided staff assistance and support to CACE.

DURATION: 3/76 - Continuing

LOCATION: MT - Statewide

DESCRIPTION: The Citizen's Advisory Committee on Energy (CACE) was named by Governor Thomas L. Judge in early 1976 to more fully involve the people in Montana in government decision-making on energy issues, particularly consideration of coal gasification. The first project of the Committee was to analyze the forecasted natural gas shortages in Montana and a study of various alternative solutions to these shortages. The Citizen's Advisory Committee on Energy established four subcommittees to accomplish their work. The subcommittees study: (1) The Remaining Natural Gas Reserves; (2) Energy Conservation; (3) Alternative Technologies; and (4) Legal Issues.

PUBLICATIONS: Report to the 1977 Legislature by the Citizen's Advisory Committee on Energy. December 1976. Available from the Montana Energy Office, Capitol Station, Helena, MT 59601.

597

PROJECT TITLE: Clarification and Standardization of the Definition, Purpose, and Practice of Ecological Baseline Studies in Western Energy Development Areas (WELUT No. 001-76)

INVESTIGATOR/ORGANIZATION: James States, Ecology Consultants, Inc., Fort Collins, CO 80521

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program, Western Energy and Land Use Team

FUNDING AMOUNT: \$563,012

DURATION: 9/76 - 1/78

LOCATION: MT, WY, ND, SD

DESCRIPTION: Objectives - (1) To create an accurate and complete definition of ecological baseline studies that is universally understandable, meaningful, and acceptable; (2) To establish the fundamental rationale, purpose, and appropriate methodology for conducting ecological baseline studies; (3) To communicate the definition and concepts of ecological baseline studies to participants in western energy development and in the environmental studies and reclamation programs related to energy development.

PUBLICATIONS: Products will include - (1) Bibliography of references; (2) Thesaurus of key terms and technical definition; (3) Recommended methods and procedures for ecological baseline studies. Contact the Project Officer, John Morrison, for information on availability. US FWS, WELUT, Room 206, Federal Bldg., Fort Collins, CO 80521.

ENERGY MANAGEMENT AND POLICY

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PROJECT TITLE: Energy-Environment Information Transfer System

INVESTIGATORS/ORGANIZATION: Gail Kuntz, Dale Horton, C.C. Gordon, Environmental Studies Laboratory, University of Montana, Missoula, MT 59801, (406) 243-2671

FUNDING AGENCY: U.S. Environmental Protection Agency

FUNDING AMOUNT: \$4,966

DURATION: 7/76 - 8/76 (Completed Phase I)

LOCATION: MT - Statewide

DESCRIPTION: The objective of the system is to provide for improved transfer of energy-environment information to decision makers in the governmental (state, local, and tribal) and private sectors. The project will be performed in two phases. Phase I will determine the information system requirements. This will consist of: (1) Identifying the users; (2) Determining user needs; and (3) Defining outputs of the system. Phase II will involve the actual design of an information transfer system and a plan to implement the system.

PUBLICATIONS: Gail Kuntz, Dale Horton. Energy/Environment Information Transfer System: Montana Information Needs. Final Report and Summary of Findings, July 1976. (EPA Order No. WT-6-99-0429-J)

599

PROJECT TITLE: Future Choices: Energy Program

INVESTIGATOR/ORGANIZATION: Michael J. Murphy, Upper Midwest Council, Federal Reserve Bank Bldg., Minneapolis, MN 55480, (612) 373-3724

FUNDING AGENCIES: Upper Midwest Council members; foundations

DURATION: 1/74 - Continuing

LOCATION: The Upper Midwest Council Region generally coincides with the 9th Federal Reserve District (MN, ND, SD, MT, Northwest WI, and Upper Peninsula of MI.)

DESCRIPTION: The Future Choices: Energy Program is an effort to identify and understand significant energy-related problems and opportunities facing the Upper Midwest. The major objective is to provide useful information to public and private decision makers and to increase the level of public discussion. Council projects involve the voluntary input and assistance from knowledgeable individuals from throughout the region, representing diverse points of view and expertise. Research activities and report development are done by the Council staff.

PUBLICATIONS: Numerous. Contact investigator for publications and price list.

600
PROJECT TITLE: Legal Aspects of Energy Development (14-16-0006-3067)

INVESTIGATOR/ORGANIZATION: Robert E. Beck, Southern Illinois University,
School of Law, Carbondale, IL 62901, (616) 536-7711

FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service,
Office of Biological Services

FUNDING AMOUNT: \$15,000 DURATION: 7/75 - 6/77 (Completed)

LOCATION: MT, WY, ND, SD, CO

DESCRIPTION: Collect, analyze and collate laws that pertain to wildlife,
wildlife habitat, and energy development in Colorado, Montana, North Dakota,
South Dakota, and Wyoming.

PUBLICATIONS: Final report to the Fish and Wildlife Service.

601
PROJECT TITLE: Montana Energy Conversion Study

INVESTIGATOR/ORGANIZATION: James H. Nybo, Montana Energy Advisory Council,
Capitol Station, Helena, MT 59601, (406) 449-3940

FUNDING AGENCY: State of Montana (Montana Energy Advisory Council)

FUNDING AMOUNT: Approx. \$3,500 DURATION: 12/75 - 1/77 (Completed)

LOCATION: MT - Statewide

DESCRIPTION: H.B. 453 called for the development of a comprehensive energy
conversion policy and plan. This project includes the specification of the
full range of energy conversion alternatives available to the citizens of the
State of Montana and develops and assembles information pertinent to the im-
plications for their application in Montana. (NOTE: This project was part
of MEAC's Energy Policy Study, Project No. .)

PUBLICATIONS: See "A Need for Balance: Montana Energy and Growth Policies,
Montana Energy Advisory Council Report, January 1977. Available from the
Montana Energy Office, Capitol Station, Helena, MT 59601.

602
PROJECT TITLE: Montana Energy Extraction Study

INVESTIGATOR/ORGANIZATION: Sharon Solomon, Montana Energy Advisory Council,
Capitol Station, Helena, MT 59601, (406) 449-3940

FUNDING AGENCY: State of Montana (Montana Energy Advisory Council)

FUNDING AMOUNT: Approx. \$4,000 DURATION: 8/75 - 1/77 (Completed)

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LOCATION: MT - Statewide

DESCRIPTION: Energy is found in many different forms in Montana, including oil, natural gas, coal, uranium, hydro, geothermal, solar and a variety of others. Article IX, Sections I and II of the Montana Constitution provides the basis for the current policy existing in Montana regarding extraction of these natural resources. Laws such as the Montana Strip and Underground Mine Reclamation Act are good examples of its implementation. However, much of the policy on energy extraction is fragmented. There exists a need in Montana for a consistent and cohesive energy extraction policy with an eye toward both short- and long-term benefits and uses. In developing this policy, careful attention must be paid not only to supply and demand questions but also to land use and social goals and end-use conservation. The purpose of this study is to develop the above extraction policy and make it consistent with the overall energy policy in Montana. (NOTE: This study is part of MEAC's Energy Policy Project, Project No. 603.)

PUBLICATIONS: See "A Need for Balance: Montana Energy and Growth Policies," A Montana Energy Advisory Council Report, January 1977. Available from the Montana Energy Office, Capitol Station, Helena, MT 59601.

603

PROJECT TITLE: Montana Energy Policy Program

INVESTIGATOR/ORGANIZATION: Bill Christiansen, Montana Energy Office, Capitol Station, Helena, MT 59601, (406) 449-3940

FUNDING AGENCY: State of Montana (Montana Energy Office)

FUNDING AMOUNT: Funding is not easily extracted from the rest of the MEO program.

DURATION: 8/75 - Continuing

LOCATION: MT - Statewide

DESCRIPTION: House Bill 453 directed the Governor of Montana to prepare and submit "directly to the Legislature a long-term, comprehensive state energy conversion policy and plan including but not limited to alternative long-term growth goals, a statewide siting inventory and a proposed siting policy for the coordinated siting of energy conversion facilities to meet Montana's energy needs." Governor Judge assigned these tasks to the Montana Energy Advisory Council (now the Montana Energy Office) and an Energy Policy Study was initiated. The Energy Policy Study has involved a number of background studies. Among them are: (1) direct burning of coal by Montana industry; (2) Montana energy conversion study; (3) Montana energy extraction study; (4) low-BTU gasification of coal for Montana applications; (5) Montana energy data project; (6) Montana renewable energy study; (7) Montana statewide siting study; (8) projections of energy consumption in Montana to 1990; and (9) a study of Montana's major energy transportation systems. The Energy Policy Study is an ongoing project and MEO continues to work towards the formulation of a comprehensive state energy policy with the built in flexibility to adapt to changing conditions.

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PUBLICATIONS: (1) A Need for Balance: Montana Energy and Growth Policies -- A Montana Energy Advisory Council Report, January 1977. Available from the Montana Energy Office, Capitol Station, Helena, MT 59601. (2) Approximately 20 background papers have been prepared in connection with the energy policy project. Most are available from the Montana Energy Office.

604

PROJECT TITLE: Montana Energy Research Coordination Program

INVESTIGATOR/ORGANIZATION: Randall Moy, Montana Energy Office, Capitol Station, Helena, MT 59601, (406) 449-3940

FUNDING AGENCY: State of Montana (Montana Energy Office)

DURATION: Continuing

LOCATION: MT - Statewide

DESCRIPTION: The chief objective of the Energy Research Coordination Program is to work toward the timely and effective use of energy research (both data and analysis) by Montana state government (and others) by serving as coordinator, communication facilitator and research information focal point. The Energy Research Coordinator interacts directly and on a continuing basis with research efforts of the university system, the federal government, state government, and private sector, and all state and federal legislation dealing in energy is tracked. In addition to the primary objective of research utilization by state government, the Energy Research Coordination Program provides leadership in the development of a state strategy for energy research. During the last year, the Energy Research Coordination Program focused on the development of plans for the maximum utilization of all types of renewable energies in the State of Montana, and the development of a delivery mechanism to provide energy information to the appropriate audience.

605

PROJECT TITLE: Montana Energy Research Inventory

INVESTIGATOR/ORGANIZATION: Nancy McLane, Montana Energy Office, Capitol Station, Helena, MT 59601, (406) 449-3940

FUNDING AGENCY: State of Montana (Montana Energy Office)

DURATION: 1/75 - Continuing

LOCATION: MT - Statewide

DESCRIPTION: The Montana Energy Office has, as one of its primary functions, the responsibility for coordination of energy-related research activities within state government. In partial fulfillment of this responsibility, MEO has established the Montana Energy Research Inventory which is used to keep track of all ongoing and recently completed energy researching occurring in or for Montana. The Energy Research Information Inventory provides a necessary information tool for researchers, state government planners and decision makers, and others involved in energy activities. By maintaining a central, comprehensive and up-to-date inventory of energy-related research, MEO hopes to: (1) Enhance communication among energy researchers; (2) Avoid unnecessary duplication of

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effort; (3) Help funding agencies pinpoint areas of additional research needs; and (4) Permit the effective utilization of research by interested persons. To accomplish the above stated objectives, the Energy Research Inventory (1) Maintains an Energy Research Matrix Board, which is continuously updated, for quick reference to information on Montana energy research; (2) Maintains research information files; (3) Prepares an annual publication in which all project information is summarized in a comprehensive report; and (4) Provides a search and referral service for individuals who wish to obtain up-to-date information on the status of any project.

PUBLICATIONS: (1) A Directory of Montana Energy Research and Development Projects -- January 1978. Prepared by Nancy McLane, Montana Energy Office; (2) Montana Energy Research -- Summer 1976. Prepared by Kathy Albertsen van Hook and James H. Nybo, Montana Energy Office, September 1976; (3) Energy Research in the Colstrip, Montana, Area, Summer 1975. Prepared by James H. Nybo, Montana Energy Office. These publications are available from the Montana Energy Office, Capitol Station, Helena, MT 59601.

606

PROJECT TITLE: Montana Environmental Quality Council Energy Policy Study

INVESTIGATORS/ORGANIZATION: Dana H. Martin, Thomas W. Frizzell, Richard Bourke, Montana Environmental Quality Council, Capitol Station, Helena, MT 59601, (406) 449-3742

FUNDING AGENCIES: Ford Foundation; State of Montana (Environmental Quality Council)

FUNDING AMOUNT: Approx. \$75,000 (Ford Found.)

DURATION: 1/73 - 6/75 (Completed)

LOCATION: MT - Statewide

DESCRIPTION: The Environmental Quality Council's Montana Energy Policy Study is designed to provide data and policy recommendations to assist Montana legislators in developing a state energy policy. The first three parts of the study trace the causes of the energy crisis, examine current energy supply and demand data, analyze the major studies investigating the problem, and suggest some decisions Montanans ought to consider. The principal finding of the study is that Montana must take immediate action if it is to protect much of its long-range agricultural base, its economic stability, its environmental quality, and its unique way-of-life. In the absence of Montana acting to determine its own destiny, the State's future will be dictated by the Federal government and the energy conglomerates whose actions, if history is any guide, will be based on expedience and profit maximization and may not coincide with what is best for Montana.

PUBLICATIONS: Dana H. Martin, Thomas W. Frizzell, Richard L. Bourke. Montana Energy Policy Study, Final Report, Revised Edition, June 1, 1975. (Out of print).

607

PROJECT TITLE: Montana Statewide Siting Study

INVESTIGATORS/ORGANIZATION: Sharon Solomon, Gail Kuntz, Montana Energy Advisory Council (now Montana Energy Office), Capitol Station, Helena, MT 59601, (406) 449-3940

FUNDING AGENCY: State of Montana (Montana Energy Advisory Council)

FUNDING AMOUNT: Approx. \$5,500 DURATION: 8/75 - 1/77 (Completed)

LOCATION: MT - Statewide

DESCRIPTION: The project was initiated by the Montana Energy Advisory Council in partial response to the directive of the 1975 Legislature that "siting of certain energy conversion facilities shall be suspended . . . until a long-term comprehensive state energy conversion policy and plan" has been prepared. The Legislature specifically called for a "statewide siting inventory and a proposed siting policy for the coordinated siting of energy conversion facilities to meet Montana's energy need." The major components of this study are: (1) An analysis and comment on the strengths and weakness of the Montana siting process; (2) The investigation of alternative options open to the State in developing a statewide siting policy and inventory; (3) A survey of the siting processes employed in six other states; (4) Considerations included in the development of criteria to guide the siting inventory effort; (5) The availability of resource data to meet the needs of a siting inventory and the availability of automated systems to facilitate the storage and analysis of data; (6) Recommendations of specific proposals designed to meet the policy and planning needs identified in the preceding sections.

PUBLICATIONS: Gail Kuntz. Montana Siting Inventory and Policy Development, A Report to the Montana Energy Advisory Council, January 1977. Available from the Montana Energy Office, Capitol Station, Helena, MT 59601.

608

PROJECT TITLE: Pacific Northwest Energy-Related Regional Assessment Program

INVESTIGATOR/ORGANIZATION: J.B. Burnham, Regional Energy Assessment Program, Battelle-Pacific Northwest Laboratory, P.O. Box 999, Battelle, Blvd., Richland, WA 99352, (509) 946-2476

FUNDING AGENCY: U.S. Energy Research and Development Administration, Division of Biomedical and Environmental Research

FUNDING AMOUNT: \$1,000,000 (FY77 \$400,000) DURATION: 7/75 - 4/78

LOCATION: AK, ID, OR, MT, WA, WY

DESCRIPTION: Under the sponsorship of the Division of Biomedical and Environmental Research of ERDA, the Battelle-Pacific Northwest Laboratories is conducting a multi-year program directed towards assessing the long-term environmental, socioeconomic, and health effects of probable and possible energy-related developments in the Northwest States. The work is intended to develop a better understanding of the regional implications of national policies, technology de-

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development activities, and actions as well as those of state and regionally developed programs and policies. After consideration of a variety of approaches to integrated assessment at a regional level, Battelle, Pacific Northwest Laboratories has concluded that dynamic simulation techniques provide the best available approach to evaluating the issues pertinent to the Northwest. As a result, the Pacific Northwest Regional Assessment Program has been structured in a framework involving ten sectors. Each of these sectors involve their own sub-models that receive information either from outside the model as exogenous inputs or from other sector submodels. The ten sectors are: energy, economic, demographic, air resources, water resources, land resources, social impacts, psychological impacts, health, and bioproductivity. In addition to the several sectors of the dynamic simulation model, a final task has as its main objective the identification and analysis of major institutional constraints to energy development in the Pacific Northwest region. Initial application of the analytical framework will be to the interlaboratory cooperative program on the National Coal Utilization Assessment being conducted by ERDA's National Laboratories.

PUBLICATIONS: Numerous. Write to investigator for a list of publications. Specific results of the assessment activities are covered in a series of annual and topical reports.

609

PROJECT TITLE: Potential Energy Corridor Requirements for the Pacific Northwest -- Long Range (1985-2020)

INVESTIGATOR/ORGANIZATION: R.B. Eastvedt, Bonneville Power Administration, P.O. Box 3621, Portland, OR 97208 (in cooperation with the U.S. Forest Service, Regions 1, 4, and 6)

FUNDING AGENCIES: U.S. Department of the Interior, Bonneville Power Administration; U.S. Department of Agriculture, Forest Service

DURATION: Completed 4/77

LOCATION: MT, WY, ID, WA, OR

DESCRIPTION: A preliminary examination of long-range energy transportation requirements based on a variety of scenarios of load growth, generation methods and energy transportation methods. The report identifies the need to consider energy corridors associated with Great Plains coal reserves in regional planning.

PUBLICATIONS: Potential Energy Corridor Requirements for the Pacific Northwest, Long Range (1985-2020). Joint BPA/FS Work Group No. 1. Copies available from: Emmet E. Willard, Bonneville Power Administration, P.O. Box 3621, Portland, OR 97208.

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PROJECT TITLE: Rocky Mountain Regional Energy Assessment Program

INVESTIGATOR/ORGANIZATION: Ronald Lahrline, Regional Energy Assessment Program, Los Alamos Scientific Laboratory, P.O. Box 1663, Los Alamos, NM 87545

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FUNDING AGENCY: U.S. Energy Research and Development Administration, Division of Environmental and Biomedical Research

FUNDING AMOUNT: Approx. \$750,000 in FY77

LOCATION: AZ, CO, ID, MT, NV, NM, UT, WY

DESCRIPTION: Under the auspices of the U.S. Energy Research and Development Administration, Division of Environmental and Biomedical Research, the Los Alamos Scientific Laboratory is engaged in a program assessing alternative energy development strategies for the Rocky Mountain West. The program's purpose is to identify and evaluate alternatives for utilization of the region's energy resources. Presently conducted under the LASL Regional Energy Assessment Program are projects on the following subjects: National Coal Utilization Assessment, Upper Colorado River Basin Optimization Model, Air Quality and Rocky Mountain Energy Development, Energy Facility Siting for the Water Resources Council, Indian Tribal Interactions, Health Cost from Energy Generated Pollutants, Regional Optimization Model for Energy Resources, Boom-Town Problems, and others.

DESCRIPTION: A list of Regional Energy Assessment Program publications is available from LASL.

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PROJECT TITLE: The Role of the Bonneville Power Administration in the Pacific Northwest Power Supply System, Including Its Participation in the Hydro-Thermal Power Program -- A Draft Program Environmental Statement and Planning Report

INVESTIGATOR/ORGANIZATION: Donald P. Hodel, Administrator, Bonneville Power Administration, Department of the Interior, P.O. Box 3621, Portland, OR 97208, (503) 234-3361

FUNDING AGENCY: U.S. Department of the Interior, Bonneville Power Administration

FUNDING AMOUNT: Approx. \$4,000,000 to date DURATION: Summer 1975 - 9/78

LOCATION: WA, OR, ID, MT

DESCRIPTION: The draft environmental impact statement describes the environmental impact of Bonneville Power Administration's participation in the regional power supply system in the Pacific Northwest, including the Hydro-Thermal Power Program, in order to provide a framework in which decisions facing BPA can be made. Particular emphasis is given to BPA's decisions concerning its relationship to the present system and power supply system alternatives for the future. The "Role EIS" is a programmatic statement which describes in broad terms the BPA program, the functions through which the program is administered, alternative programs and alternative implementing actions, and environmental impacts. The EIS is intended to insure that BPA's Administrator and other decisionmakers are informed of alternatives related to their decisions, impacts associated with each alternative, and potential environmental consequences. The statement was prepared in compliance with the National Environmental Policy Act of 1969.

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PUBLICATIONS: The Role of the Bonneville Power Administration in the Pacific Northwest Power Supply System Including Its Participation in the Hydro-Thermal Power Program -- Draft Program Environmental Statement and Planning Report (DES 77-21), prepared by Bonneville Power Administration, Department of the Interior, July 22, 1977. Part I. The Regional Electric Power Supply System; Part II. The Role of BPA; Appendix A. BPA Power Resources, Aquisitions, Planning and Operations; Appendix B. BPA Power Transmission; Appendix C. BPA Power Marketing; Summary Report.

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PROJECT TITLE: Study of Agriculture/Energy Interrelationships

INVESTIGATOR/ORGANIZATION: Joseph Stinchfield, Upper Midwest Council, Federal Reserve Bank Bldg., Minneapolis, MN 55480, (612) 373-3724

FUNDING AGENCIES: Upper Midwest Council Members; Foundations

DURATION: 3/76 - 6/77 (Completed)

LOCATION: The region encompassed by this study generally coincides with the 9th Federal Reserve District (MN, ND, SD, MT, northwest WI, and upper peninsula of MI)

DESCRIPTION: This study is the product of one phase of the Upper Midwest Council's land use program. The study surveys the characteristics of energy use in the food system, the effects that rising energy prices and declining energy supplies will have on the food system, and explores policy options for reducing the adverse effects of energy uncertainties. The study concluded that rising energy prices will increase food production, processing, and marketing costs and result in higher retail food prices. Most food producers will successfully adjust to developing energy problems; however, the more energy intensive production systems such as irrigated crop production and feedlot cattle production may experience severe economic problems. Natural gas supply will be the most critical energy problem in the food processing system. Lack of natural gas will necessitate expensive conversion to alternate fuels. Continued consolidation of marginal food processing facilities will result. Policy recommendations address issues on energy price and supply regulation, energy allocation priorities, food and energy policy and energy conservation.

PUBLICATIONS: Joseph Stinchfield. Impacts of Energy Uncertainties on the Food System in the Upper Midwest. June 1977, 118 pages, \$5.00. Available from the Upper Midwest Council.

613

PROJECT TITLE: Technology Assessment of Western Energy Resource Development (EPA No. 68-01-1916)

INVESTIGATORS/ORGANIZATIONS: Irvin L. White, University of Oklahoma, Science and Public Policy Program, 601 Elm Ave., Room 432, Norman, OK 73019, (405) 325-2554; F. Scott LaGrone, Radian Corporation, 8500 Shoal Creek Rd., Box 9948, Austin, TX 78766, (512) 454-4797

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FUNDING AGENCY: U.S. Environmental Protection Agency, Office of Energy, Minerals and Industry

FUNDING AMOUNT: \$1,787,186

DURATION: 7/75 - 7/78

LOCATION: MT, ND, SD, WY, UT, CO, AZ, NM

DESCRIPTION: A three-year technology assessment of coal, oil, natural gas, oil shale, uranium, and geothermal resource development in the Western United States. Technology assessment is being developed as a policy-making tool for systematically identifying, defining and evaluating the full range of economic, social, environmental, institutional, and other first and higher order consequences likely to result from the introduction, extension, or modification of technologies. Taking into account both the quantitative and qualitative costs, risks, and benefits of either a technology or alternative technologies, assessors identify, analyze, evaluate, and compare alternative policies and implementation strategies.

PUBLICATIONS: Irvin L. White, et. al. First Year Work Plan for a Technology Assessment of Western Energy Resource Development. Available from NTIS, 1976. Also -- Irvin L. White, et. al. Energy from the West: A Progress Report for a Technology Assessment of Western Energy Resource Development. Volume I Summary, Volume II, Volume II, July 1977. (EPA-600/7-77-072a, b, c.)

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PROJECT TITLE: A Study of Montana's Major Energy Transportation Systems

INVESTIGATOR/ORGANIZATION: Paul Polzin, Bureau of Business and Economic Research, University of Montana, Missoula, MT 59801, (406) 243-5113

FUNDING AGENCY: State of Montana (Montana Energy Advisory Council)

FUNDING AMOUNT: Approx. \$4,500

DURATION: 9/76 - 12/76 (Completed)

LOCATION: MT - Statewide

DESCRIPTION: This study included an inventory and description of existing energy transportation systems in Montana, including electrical transmission systems, oil and gas pipelines, and coal transportation systems. In addition, the study analyzed the economic costs and benefits of potential new energy transportation systems for Montana, including AC vs. DC transmission of electricity, export of coal via slurry and/or railroad, Arctic Gas Pipeline vs. ALCAN Pipeline for Alaskan natural gas, Northern Tier Pipeline vs. Transprovincial Pipeline for feedstock for Montana refineries, and any additional planned or proposed energy transportation systems for Montana.

PUBLICATIONS: Paul Polzin. Montana's Major Energy Transportation Systems: Current Conditions and Future Developments. January 1977. Available from the Montana Energy Office, Capitol Station, Helena, MT 59601.

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PROJECT TITLE: Western Regional Energy Facility Siting Study

INVESTIGATOR/ORGANIZATION: Fred A. Gross, Jr., Western Interstate Nuclear Board, P.O. Box 15038, Lakewood, CO 80215, (303) 238-8383

FUNDING AGENCIES: U.S. Nuclear Regulatory Commission; Western Interstate Nuclear Board

FUNDING AMOUNT: \$51,644 (NRC); \$11,847 (WINB)

DURATION: 5/76 - 4/77 (Completed)

LOCATION: AZ, CA, CO, ID, MT, NV, NM, OR, UT, WA, WY

DESCRIPTION: This study is directed at identifying some of the existing and emerging issues, problems and conflicts that may arise in the planning and siting of electrical energy facilities in the WINB region. More specifically, the NRC contract set out two objectives of the project, to wit: (1) The identification and assessment of current and emerging issues and problems that are primarily of a multi-State, regional, nature concerning the siting and planning of nuclear and other electrical energy facilities in the Western region of the U.S.; and (2) Preparation of recommendations and alternative courses of action by state, federal and regional agencies for streamlining the regulatory and decision-making processes involved in the siting of nuclear and other electric energy facilities.

PUBLICATIONS: Regional Factors in Planning and Siting Electrical Energy Facilities in the Western States. Executive Summary, Volume I (Background and Methodology), Volume II (The Western Systems Coordinating Council Regional Interconnections, Reliability, Economy and Efficiency). April 5, 1977. (Under Contract No. AT (49-24)-0249).

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PROJECT TITLE: Energy Research Information System (ERIS)

INVESTIGATOR/ORGANIZATION: Cathy Boyd, Old West Regional Commission, 228 Hedden-Empire Building, Billings, MT 59101, (406) 657-6665

FUNDING AGENCY: Old West Regional Commission

DURATION: 11/74 - Continuing

LOCATION: Old West Region states - MT, NE, ND, SD, WY

DESCRIPTION: The Energy Research Information System (ERIS) is a service administered by the Old West Regional Commission in response to the need for current information on research activities in the Region's rapidly growing and changing field of energy. Cooperating with the Commission on ERIS is the U.S. Bureau of Land Management, EMRIA program (Energy Minerals Rehabilitation Inventory and Analysis). The purpose of ERIS is to compile and make available to the energy research users of the Region an up-to-date inventory of ongoing and recently completed energy-related research projects. By providing researchers with a means of communication with other researchers and allowing government and policy decision-makers access to Regional energy research, ERIS aims to improve communication

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channels among energy research users. Use of the system can be an aid in conducting research assessments, avoiding duplication, and pinpointing areas of additional research need.

PUBLICATIONS: ERIIS information is stored in a computerized data base. As the data base grows, periodic reports are printed which list the latest contents of the data base. Project reports which are currently available from the Old West Regional Commission are: Vol. I, No. I (Nov. 1975); Vol. I, No. II (Feb. 1976); Vol. I, No. III (May 1976); Vol. I, No. IV - Cumulative Indexes to contents of year's accumulation (Aug. 1976); Vol. II, No. I (Jan. 1977); Vol. II, No. II (April 1977); Vol. II, No. III (Nov. 1977); Vol. II, No. IV - Cumulative Indexes to contents of year's accumulation (Dec. 1977).

6. OTHER

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PROJECT TITLE: Citizen's Workshops on Energy and the Environment

INVESTIGATOR/ORGANIZATION: Larry D. Kirkpatrick, Science Math Resource Center, Montana State University, Bozeman, MT 59715, (406) 994-4912

FUNDING AGENCY: U.S. Energy Research and Development Administration

FUNDING AMOUNT: \$2,500

DURATION: 7/76 - 9/77

LOCATION: MT - Statewide

DESCRIPTION: Citizen's Workshops are educational programs that give citizens an opportunity to learn more about energy and environmental needs and problems. Participants get a chance to try their hand at solving some of the energy-environment problems facing the nation today. A full workshop program has three parts: (1) A slide orientation dealing with the basic fact related to energy problems; (2) A decision-making game played by participants using the Energy-Environment Simulator to observe the effects of a wide range of decisions involving energy use and environmental protection; and (3) A feedback session where questions raised by the program are discussed. The Energy-Environment Simulator is a specially designed analog computer that simulates real-world conditions. Energy resources, energy demands, and environmental effects are programmed into the electronic device. As the clock speeds time by at the rate of a century a minute, participants must make decisions about the allocation of energy resources. They do this by turning dials on remote panels in response to the changing situations. The simulator constantly translates these commands into new conditions.

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PROJECT TITLE: Demonstration of a Digitizing and Compositing Program for Natural Resource Data

INVESTIGATOR/ORGANIZATION: R. Thomas Dundas, Research and Information Systems, Dept. of Community Affairs, Capitol Station, Helena, MT 59601, (406) 449-2896

FUNDING AGENCY: Old West Regional Commission

FUNDING AMOUNT: \$69,910

DURATION: 6/75 - 6/77 (Completed)

LOCATION: MT (Southern portion of Rosebud County); ND

DESCRIPTION: The primary objective of this project is to demonstrate the capabilities of a digitizing and compositing program for natural resource data. The program will include: (1) Obtaining resource data for soils, vegetation-habitat and wildlife for sample areas of Montana and North Dakota. The southern portion of Rosebud County is designated for Montana; (2) Digitize base map features for North Dakota and Montana areas selected for study; (3) Digitize modern Soil Conservation Service soil survey data; (4) Digitize vegetation-habitat data; (5) Digitize wildlife distribution and critical area data for the selected project areas; (6) Obtain and digitize recreation site and land ownership data as available for the Montana area only; (7) Overlay

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maps of the following types will be inputted from the system for the selected areas in at least two different scales: (a) Base maps with digitized features; (b) Soil survey data; (c) Vegetation-habitat data; (d) Wildlife distribution and critical area data; (e) Recreation site and land ownership data for the Montana area only; (8) A demonstration of the cellular compositing technique using at least four of the above listed values will be provided to the Commission upon completion of the study. The project will demonstrate the interpretations and parameters that can be analyzed from this type of program.

PUBLICATIONS: (1) A series of computer produced maps for ND and MT areas; (2) Natural Resource Computer Mapping Demonstration Project. June 1977.

619

PROJECT TITLE: Energy Data Base

INVESTIGATOR/ORGANIZATION: R. Thomas Dundas, Jr., Research and Information Systems, Montana Dept. of Community Affairs, Capitol Station, Helena, MT 59601, (406) 449-2896

FUNDING AGENCY: State of Montana (Mt. Dept. of Community Affairs)

FUNDING AMOUNT: Less than \$1,000.

DURATION: 7/76 - continuing

LOCATION: MT - Statewide

DESCRIPTION: This project consists of the automation of energy production files of various Montana state agencies. Files automated to date are: (1) Gas and oil production data at the field level from the Montana Dept. of Natural Resources and Conservation; (2) Refining data from Montana refineries from the Montana Dept. of Natural Resources and Conservation; (3) Oil, gas and coal production information by year from the Montana Dept. of Revenue; (4) Coal production information, by firm, by year, from the Safety and Health Bureau, Montana Department of Labor and Industry.

PUBLICATIONS: Computer files on gas, oil and coal production, and oil refining.

620

PROJECT TITLE: Evaluation and Implementation of Redevelopment Alternatives for Valley Industrial Park, Montana (C-77-02)

INVESTIGATOR/ORGANIZATION: J. Andrew Kissner, Montana Trade Commission, P.O. Box 767, Butte, MT 59701, (406) 723-3228

FUNDING AGENCY: U.S. Department of Commerce, Economic Development Administration

FUNDING AMOUNT: \$247,000

DURATION: 7/77 - 6/78

LOCATION: MT - Valley County (Valley Industrial Park)

DESCRIPTION: The study addresses six articulated potential development areas: (1) Farm implement manufacturing; (2) Solar component manufacturing; (3)

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Wind component manufacturing; (4) Railcar manufacturing; (5) Residential furnace manufacturing; (6) Energy-related development strategy. The contractor is committed to approach each area utilizing a combination of resources. The objective of the study is to respond to defined goals of Valley Industrial Park, Inc., the State of Montana, and the Federal level culminating in projects which will contribute to the timely economic reuse of the former Strategic Air Command base at Glasgow, Montana.

621

PROJECT TITLE: An Energy-Related Feasibility Study and EIS for Reuse of Glasgow Air Force Base in Valley County, Montana

INVESTIGATOR/ORGANIZATION: Dan Dolenc, Mark Burrell, Montana Energy and MHD Research and Development Institute, P.O. Box 3809, Butte, MT 59701, (406) 494-4569

FUNDING AGENCY: Old West Regional Commission FUNDING AMOUNT: \$1,090,422

DURATION: 4/77 - 7/78 LOCATION: MT - Valley Co. (Glasgow AFB)

DESCRIPTION: MERDI will study the feasibility of an energy development center and analyze the environmental impact of siting energy facilities at Glasgow Air Force Base, Montana. The project will focus on conventional energy-producing facilities as well as the use of "soft" technologies -- solar and wind. A complete, dynamic energy-economic computer model of Montana will be developed which will be used to assess Montana energy supply and demand through the year 2000. Conventional energy forms, alternative energy sources, and energy supplies will be modeled. From these, a number of forecasts will be developed to give a prediction of the needs of Montana's primary, secondary, governmental, and household sectors. Also, energy effects and capital constraints will be included which describe how changing energy policies and prices affect these sectors. The baseline characteristics and environmental conditions of the area will be established based on the following criteria: wildlife, vegetation, water quality and aquatic ecology, and meteorology. To accomplish this task, field research will be conducted for one year, and a meteorological tower will be installed and operated. (NOTE: Funds for the study were transferred to the Commission by the Department of Defense which is charged with responsibility for maintaining the former air base.)

PUBLICATIONS: Interim reports to the Old West Regional Commission, 228 Hedden-Empire Building, Billings, MT 59101.

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PROJECT TITLE: League of Women Voters of Montana Energy Education Program

INVESTIGATORS/ORGANIZATION: Grace Edwards, LWV of Montana, 140 South Crestwood Drive, Billings, MT; Jenny Younger, LWV of Montana, Rt. 3, Box 155A, Bozeman, MT 59715

FUNDING AGENCY: U.S. Energy Research and Development Administration (pass-through grant to the League of Women Voters)

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FUNDING AMOUNT: \$2,200

DURATION: 9/77 - 5/78

LOCATION: MT - Statewide

DESCRIPTION: The League of Women Voters, in cooperation with knowledgeable "experts" from colleges and universities, will demonstrate the ERDA Energy-Environment Simulator to various organizations, clubs, associations, and other groups. League responsibilities will include: (1) Arranging for slide show; (2) Training ten League leaders in use of the Simulator; (3) Arranging meetings in the eight target areas; (4) Scheduling the Simulator; (5) Arranging transportation of Simulator; (6) Preparing and distributing fact sheets; (7) Using the simulator with audiences; (8) Arranging for "experts'" participation. The project graphically shows the limitations of fossil fuels in a variety of energy use mixes. It actively involves the audience in selecting energy options, tying them in with population growth, environmental consequences, and food supply. It shows how conservation of energy will help forestall a crisis until new technologies take effect.

623

PROJECT TITLE: Mineral Ownership File

INVESTIGATOR/ORGANIZATION: R. Thomas Dundas, Jr., Research and Information Systems, Montana Department of Community Affairs, Capitol Station, Helena, MT 59601, (406) 449-2896

FUNDING AGENCY: State of Montana (Montana Dept. of State Lands, and the Montana Dept. of Community Affairs)

FUNDING AMOUNT: Approx. \$2,000 (State Lands); Approx. \$1,500 (Community Affairs)

DURATION: 4/76 - continuing

LOCATION: MT - Statewide

DESCRIPTION: This file is composed of two parts: state subsurface mineral ownership and federal subsurface mineral ownership. The state file consists of the automation of mineral ownership from the State Department Lands for approximately twenty counties. This file may be expanded in the future to include all areas of the State. The federal mineral ownership was coded from Bureau of Land Management mineral management maps and presently includes positions of four counties in southeast Montana.

PUBLICATIONS: Computer files for state and federal surface and sub-surface mineral ownership.

624

PROJECT TITLE: Montana Energy Data Project

INVESTIGATOR/ORGANIZATION: Rick Itami, Montana Energy Office, Capitol Station, Helena, MT 59601, (406) 449-3940

FUNDING AGENCY: State of Montana (Montana Energy Office)

OTHER

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DURATION: 1/76 - Continuing

LOCATION: MT - Statewide

DESCRIPTION: This project involves assembling and assessing Montana energy data and inputting this data into a data storage and retrieval system. Data is primarily collected from published reports of state and federal agencies and energy-related trade journals. The primary objectives of the project are to: (1) Make the data more easily interpreted and more readily available to state agencies and researchers involved in Montana energy demand studies; (2) Provide verification of this data between the various sources; (3) Provide a flexible interface with state and regional energy modeling; and (4) Provide computerized access to data base for updating and retrieval.

PUBLICATIONS: (1) Montana Historical Energy Statistics, Terry Wheeling, September 1976; Revised Edition, Rick Itami, February 1978; (2) Energy Consumption by Forestry and Agriculture in Montana, Terry Wheeling, September 1976; (3) Consumption of Natural Gas and Electricity in Montana, Terry Wheeling, July 1976; (4) Montana's Natural Gas Situation, Terry Wheeling, June 1976; (5) Montana Petroleum Situation, Terry Wheeling, September 1976.

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PROJECT TITLE: Montana Energy Resources Mapping Project

INVESTIGATOR/ORGANIZATION: Robert L. Taylor, Department of Geography, Montana State University, Bozeman, MT 59715, (406) 994-3331

FUNDING AGENCY: State of Montana (Montana Energy Advisory Council)

FUNDING AMOUNT: \$2,100

DURATION: 9/76 - 2/77 (Completed)

LOCATION: MT - Statewide

DESCRIPTION: This map, on a scale of 1:1,000,000 will depict major known energy reserves, conversion facilities, and transportation systems in a multi-color format.

PUBLICATIONS: State of Montana Energy Map. Prepared for the Montana Energy Advisory Council by the Dept. of Earth Sciences, Montana State University, February 1977. Available from the Montana Energy Office, Capitol Station, Helena, MT 59601.

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PROJECT TITLE: Undergraduate Research Participation

INVESTIGATOR/ORGANIZATION: V. Hugo Schmidt, Department of Physics, Montana State University, Bozeman, MT 59715, (406) 994-3614

FUNDING AGENCY: U.S. National Science Foundation

FUNDING AMOUNT: \$22,320

DURATION: 6/75 - 9/75 (Completed)

LOCATION: MT

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DESCRIPTION: The following projects were conducted to involve undergraduates from Montana State University and neighboring schools in energy-related research: (1) Domestic Water Heated from Furnace Combustion Gases; (2) Energy Conservation and Building Performance; (3) Analytical Procedures Applied to Energy Sources and Their Pollutants; (4) Geological and Geochemical Studies of Hot Springs; (5) Photoemission Studies of Surfaces; (6) Materials Studies Using Van de Graaff Accelerator; (7) Energy Transfer in Solid State Laser Materials; (8) Wind Energy Supplementation of Residential Power; (9) Fieldwork Projects in Sociology.

PUBLICATIONS: Undergraduate Research Participation, Final Report to the National Science Foundation under NSF Grant No. EPP75-04633.

627

PROJECT TITLE: Energy Minerals Rehabilitation Inventory and Analysis (EMRIA)

INVESTIGATOR/ORGANIZATION: For Montana and North Dakota portion of the EMRIA Program, contact Fred Waldhaus, U.S. Bureau of Land Management, 316 N. 26th St., Billings, MT 59101, (406) 657-6474. For information on the overall EMRIA program, contact the U.S. Bureau of Land Management, Denver Federal Center, Denver, CO 80225, (303) 234-2333

FUNDING AGENCY: U.S. Department of the Interior, Bureau of Land Management

FUNDING AMOUNT: FY77 \$1,118,000 (MT & ND portion of the EMRIA program)

DURATION: 9/74 - Continuing

LOCATION: MT, ND, CO, NM, UT, WY

DESCRIPTION: The Bureau of Land Management (BLM) has been designated to administer the EMRIA program which is a Department of the Interior effort. The purpose of the program is to determine the reclamation potential of coal lands affected by coal development. This is accomplished by contracting with the Bureau of Reclamation to drill a series of holes on BLM selected sites and to collect and analyze samples of soil, overburden, coal, and substrata. Vegetation is also identified. In addition, contracts or work orders are executed with the U.S. Geological Survey to collect and analyze water samples. In summation, the drilling and studies will be aimed at securing the chemical and physical data on a profile from the surface through the strippable coal resources and into the underlying strata to a depth of 25 feet below the coal. Interpretation of these data will serve as a basis for: (1) Assessing the reclamation potential prior to leasing; (2) The preparation of site specific stipulations for energy exploration, mining and reclamation plans; (3) To provide baseline data for soils, surface water and groundwater on which to monitor changes that may occur on these resources during and after strip-mining of coal. Montana study areas are: Pumpkin Creek, Bear Creek, Dam Creek, Otter Creek East, and Hanging Woman.

PUBLICATIONS: Separate reports for each of the study sites are being completed and will be available from the EMRIA program, U.S. Bureau of Land Management, Billings, MT 59101.

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ORGANIZATION: The Montana Energy and MHD Research and Development Institute, Jerry D. Plunkett, Director, P.O. Box 3809, Butte, MT 59701, (406) 494-6100

FUNDING AGENCIES: U.S. Energy Research and Development Administration. Numerous other funding sources.

FUNDING AMOUNT: The Institute had about \$6.7 million in research contracts in FY77. About \$3.5 million is used for MHD research. The balance goes for other energy research: Technical support for NCAT - \$890,726; Mt. Energy Conservation Plan - \$45,100; Fuel Cell Development Study - \$246,934; Univ. of Oklahoma Electrical Unit Model - \$11,726; Feasibility Study of Heating Warm Springs State Hospital with Geothermal Sources - \$9,000; Investigation of the Dependence of Thermal Conductivity and Diffusivity of Modern Engineering Ceramics - \$40,165; Establishment of a Center for Innovation - \$800,000; Site Suitability Study of Glasgow Air Force Base as an Energy Park - \$1,090,422.

DURATION: 3/75 - Continuing

LOCATION: Nationwide

DESCRIPTION: The Montana Energy and MHD Research and Development Institute (MERDI) was established in 1975 to develop methods for efficiently conserving and utilizing western energy sources and to carry out a major research and hardware phase of the U.S. Energy Research and Development Administration's MHD program. Currently, the Institute is overseeing an extensive research and development effort within Montana's university units, and it has also assumed responsibility for the testing and construction of MHD experimental facilities within the state. MERDI also will conduct an evaluation and analysis of MHD's environmental, social, and economic impact. Although MHD research was the primary reason for MERDI's establishment, the Institute is expanding its role to include research on alternate energy sources such as solar, wind, and geothermal. It also will be working on energy conservation. MERDI conceived and is helping to establish the National Center for Appropriate Technology (NCAT), a non-profit corporation that will develop a number of small, energy conserving devices and procedures for assisting lower income Americans. The Center for Innovation (CFI), a division of MERDI, was recently started to promote the development and introduction of alternative technology. The purpose of the Center will be to generate projects which translate into small business applications that produce and market newly developed technology utilizing renewable energy resources.

PUBLICATIONS: Contact MERDI for a list of available publications.

629

ORGANIZATION: Montana Office of Appropriate Technology, Dan Newman, Director, Mt. Dept. of Natural Resources and Conservation, 32 So. Ewing, Helena, MT 59601

FUNDING AGENCIES: National Center for Appropriate Technology - \$25,000; Comprehensive Employment Training Act (Dept. of Labor) - \$63,700 for salaries; State of Montana, Dept. of Community Affairs - \$5,400 salary; State of Montana, Dept. of Natural Resources and Conservation - \$40,300 ranch value.

DURATION: 7/77 - Continuing

LOCATION: The Montana Office of

Appropriate Technology learning center will be located at Nevada Creek Ranch. There will also be an information transfer office located in Helena, Montana.

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DESCRIPTION: The long-term objective of the Montana Office of Appropriate Technology (MOAT) is the better utilization of publicly-owned natural resources for small scale community based economic development opportunities and labor intensive energy efficient natural resource development. Among the proposed activities and elements of MOAT are: An Appropriate Technology and Energy Conservation Learning Center located at the Nevada Creek Ranch which will (1) Demonstrate and test energy efficient and renewable resource family farm sized agricultural technology; (2) Provide residential training for state employees, local government employees, citizen leaders, and private non-profit organization employees and board members on energy management, local energy planning, low cost renewable resource technology, and community development. There will be an Information Transfer Office located in Helena. A guiding principle in the selection of MOAT activities will be the conversion of fossil fuel energy intensive consumption to renewable resource based local production.

PUBLICATIONS: Interim Report -- Montana Offices of Appropriate Technology, June 15, 1977, Montana Dept. of Natural Resources and Conservation, 32 South Ewing, Helena, MT 59601.

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ORGANIZATION: The National Center for Appropriate Technology (NCAT), Jim Schmidt, Director, P.O. Box 3838, Butte, MT 59701, (406) 723-6533

FUNDING AGENCY: U.S. Community Services Administration

FUNDING AMOUNT: \$3, 086,546 (FY77)

DURATION: 10/76 - Continuing

LOCATION: Nationwide; Butte, MT (Center location)

DESCRIPTION: The National Center for Appropriate Technology will carry out a program of research and development, with a specific mission in its first year of developing, modifying, adapting, and implementing technologies which can be helpful to poor people, particularly in dealing with the problems of rapidly increasing energy cost, and with a specific focus on technological support to the CSA weatherization program. Some of the research and development work will take place in Montana through the Center's own staff, and most importantly through a delegate agency contract with the Montana Energy and MHD Research and Development Institute (MERDI). Another important situs for developmental and demonstration activities will be local communities, which through delegate agency agreements with Community Action Agencies, Community Development Corporations, and other eligible grantees will be given financial and technical resources for carrying out projects which contribute to the overall mission of the Center. The Board of the Center has identified four principal areas for investigation for the first year's work program: (1) Weatherization of mobile homes; (2) The development of a safe, efficient, and inexpensive flue damper for hot water heaters and furnaces; (3) Improvement in the technology of the manufacture of cellulose fiber insulation with the aim of significantly reducing the capital cost; and (4) The development of low cost energy efficient cooling and ventilating systems. Two additional areas are provided for in the budget, and are to be identified during the course of the year from field experience. The Center's first year budget is

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roughly equally between three major areas of activity: (1) Information exchange, outreach, education and technical assistance, planning and development of priorities, to be carried out directly by the Center staff; (2) Research development, and technical support, to be contracted mostly to MERDI, with provision for some other small contracts; and (3) Support and evaluation of community experiments and demonstrations, through delegate agreements to CAAs and CDCs.

PUBLICATIONS: The Center will publish a newsletter as well as occasional technical papers designed to disseminate and exchange information on developments in the field of technologies appropriate to the needs of the poor.

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PROJECT TITLE: Surface Environment and Mining (SEAM)

ORGANIZATION: Surface Environment and Mining, U.S. Forest Service, Kenneth Scholz, SEAM Program Manager, 145 Grand Avenue, Billings, MT 59102, (406) 657-6468

FUNDING AGENCY: U.S. Department of Agriculture, Forest Service

DURATION: 7/73 - 9/79

LOCATION: MT, WY, NM, UT, ND, ID

DESCRIPTION: The Surface Environment and Mining Program, known as SEAM, was established by the Forest Service in 1973 and given a five-year mission to develop and apply the most current reclamation and planning technology. SEAM is concentrating its efforts in the West because of keen interest in developing new energy and mineral deposits. The research, planning, and application projects underway are primarily directed toward helping Forest Service land managers effectively handle mineral management problems. However, SEAM-generated information is also being used by other federal and state agencies, mining companies, and decision makers at all levels. SEAM projects cover the whole spectrum of mining activity, from pre-exploration, exploration, leasing, and development, through final reclamation. Model demonstration sites have been established throughout the West to develop and demonstrate the most current reclamation technology. Major emphasis is being directed toward developing technology transfer systems that will funnel available knowledge to the various user groups in an understandable and useable form. (NOTE: SEAM is attached to the Intermountain Forest and Range Experiment Station, Ogden, UT.)

PUBLICATIONS: For information on available publications, contact the SEAM office in Billings.

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PROJECT TITLE: Western Energy and Land Use Team (WELUT)

INVESTIGATOR/ORGANIZATION: Terry McGowan, Team Leader, Western Energy and Land Use Team, Office of Biological Services, U.S. Fish and Wildlife Service, USDI, Room 206, Federal Building, 301 S. Howes St., Fort Collins, CO 80521, (303) 221-2040

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FUNDING AGENCY: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program

FUNDING AMOUNT: Approx. 1M - FY77 (WELUT Team); Approx. 6.6M has been contracted out.

DURATION: Fall 1975 - Continuing

LOCATION: Western States, particularly MT, WY, CO, ND, UT, NM

DESCRIPTION: The Western Energy and Land Use Team (WELUT) is part of the Biological Services Program of the United States Fish and Wildlife Service. The basic mission of the Biological Services Program and WELUT is to strengthen the ecological basis for renewable resource management, land-use decisions, and the formulation of environmental regulations. The specific responsibility of WELUT is to provide information that will enhance consideration of fish and wildlife values in decisionmaking processes. Efforts of the Team are focused on ecosystems likely to be stressed by energy developments and other land-use changes. Currently the Team has studies and other activities directed towards problems associated with development of coal, oil shale, and geothermal resources and the allocation of water for these and other purposes. Other resource development areas will be addressed as needs arise.

PUBLICATIONS: Contact the Information Transfer Specialist at WELUT for a list of available publications.

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The Personal Name Index contains the names of the investigators, supervisors, and authors of publications for each project.

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APPENDIX A

RESEARCH QUESTIONNAIRE

INSTRUCTIONS: Please complete this questionnaire for each energy-related project being conducted or recently completed by your organization. If an umbrella project covers several separate studies, fill out a form for each one, as well as for the umbrella project.

2. PRINCIPAL INVESTIGATOR:

OTHER INVESTIGATORS:

Address

4. OTHER AGENCIES/INSTITUTIONS PARTICIPATING IN PROJECT (Specify their role):

6. ACTUAL COMPLETION DATE (Leave blank if not completed):

TOTAL FUNDING \$ _____

If this is a federally funded project, have you specified the state share (if any)?

(SEE OTHER SIDE)

8. GEOGRAPHIC AREA (What states and counties does this project address?):

OTHER LOCATION INFORMATION (If appropriate, give region, river basin, city, township/range, section, etc.):

9. REPORTS AND PUBLICATIONS (Give title, authors, report number, date, issuing agency, and where report can be obtained):

10. DESCRIPTIVE ABSTRACT (Objectives, approach, etc. Please feel free to enclose any relevant proposals, contracts, or reports.):

Respondent _____

Date _____

